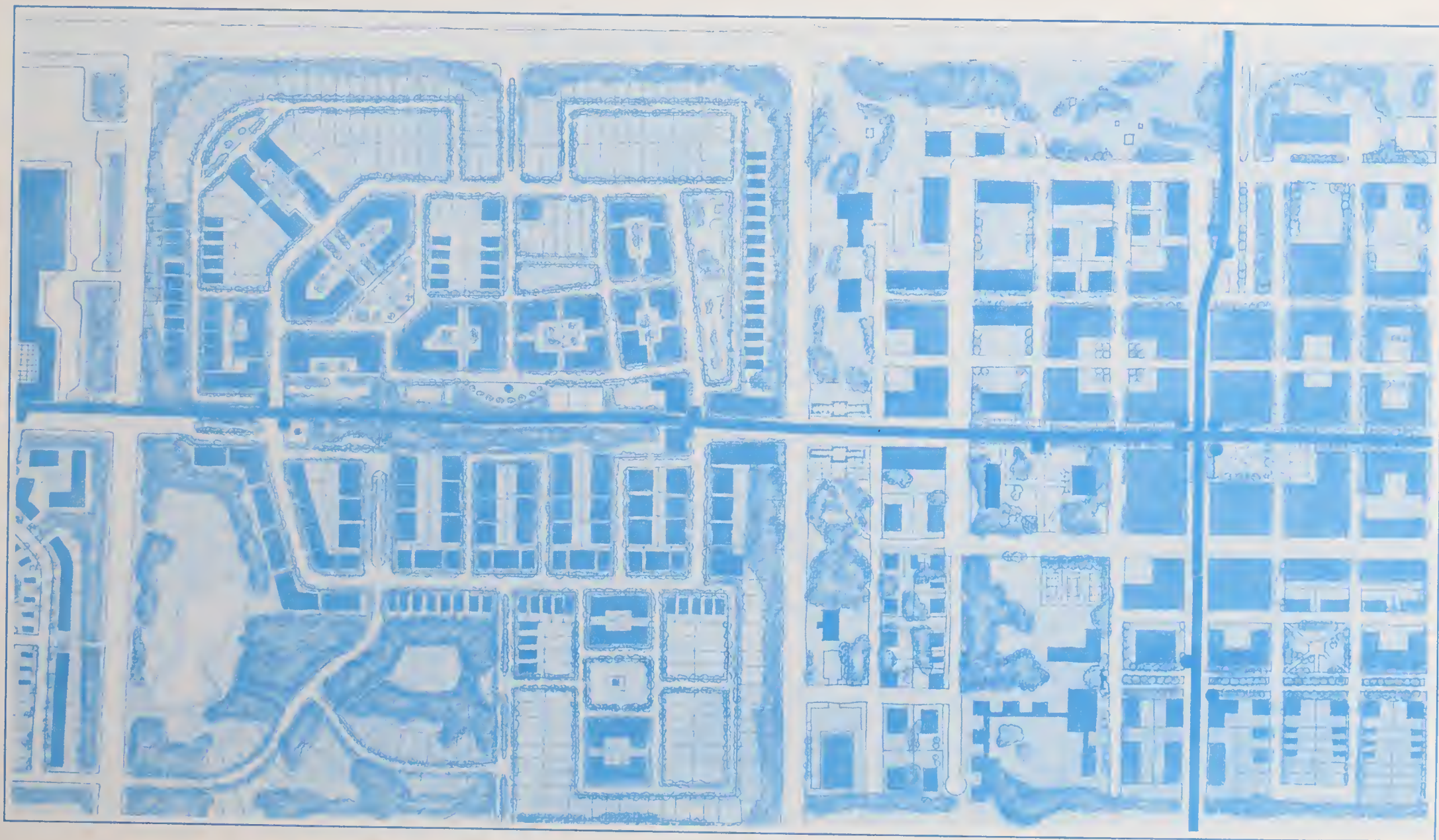




U.S. Department
of Transportation

Guidelines for Transit-Sensitive Suburban Land Use Design

July 1991



Guidelines for Transit Sensitive Suburban Land Use Design

Final Report
July 1991

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ABSTRACT

This report provides guidelines for the planning and design of land use patterns that are sensitive to the needs of public transit. These guidelines are meant to create an efficient environment for future growth in suburban areas. The guidelines have been prepared from a market-based point of view. Design elements are proposed that directly address the success of development activities and transit services. The report discusses requirements for successful transit and provides design guidelines for land use, access systems and transit service types through a range of scales.

Transit-sensitive land use design can be developed through the designation of Transit Corridor Districts (TCDs) which would separate transit- and auto-oriented land uses. Such areas would have a mix of land uses with higher densities located near a transit route. A high quality access system for pedestrians and bicyclists should be provided to permit easy connections between buildings and transit vehicles. Guidelines are developed for the overall administrative and policy issues, systems planning considerations and specific designs of individual districts where transit service is provided. Steps to implement the guidelines are also included.

A prototype Transit Corridor District, based on the guidelines, is presented in the final section of this report. The proposed TCD illustrates how the guidelines can be applied at a specific location.

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INTRODUCTION

PART I: INTRODUCTION AND CONCEPTS

A. Introduction

"Travel patterns in the suburbs are highly diverse with trips from many origins to many destinations and few concentrated corridors of demand."

During the past several decades there has been a rapid growth in the level and complexity of suburban activity. Suburban areas which were once bucolic bedroom communities for commuters into a central business district have become multifunctional areas with a full range of employment, business and institutional activities which rival the downtowns of most metropolitan areas. A diverse set of activities which includes all aspects of modern life have become available in the suburbs as well as the problems associated with these changes. No longer are suburban streets quiet avenues. They have become crowded arterials with severe traffic congestion and safety problems. In addition, unsafe levels of air pollution are a direct result of this growth in automobile traffic. Sprawl has withered the suburban ambience and the convenience and comfort of suburban living.

Beginning in the early 1980's these problems began to be recognized and solutions developed to relieve suburban congestion. Travel patterns in the suburbs are highly diverse with trips from many origins to many destinations and few concentrated corridors of demand. Activity centers and trip generators are poorly tied to each other and scattered in many locations. Suburban buildings are difficult to access by transit or by foot in a auto-dominated world. Finally, transit was not considered in land development, planning and implementation decisions and is difficult to retrofit transit into a suburban environment. Efforts to provide public transport to the suburbs have had limited success.

Most work on the problem of transit in suburban areas to date has concentrated on the development of new methods of operation or administration of public transit

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services in suburban areas. Demonstration projects have been attempted and new services have been offered with the hope of finding a "magic" transit solution to suburban travel problems. While these efforts certainly have merit they tend to ignore the underlying land use planning and design issues that are the root of many of these problems. More recent efforts to rethink suburban land use as outlined in an accompanying report¹ provides new directions for suburban planning and design. These efforts have led to a model of the suburbs which integrates land use and transit services and a movement away from the auto-dependent suburbs.

"These guidelines result in suburbs which provide a mix of land uses and a high quality access system using walking and bicycle pathways to link land use with transit service."

This report provides guidelines for land use planning, design and development that are sensitive to the operational and economic requirements of public transit systems. These guidelines result in suburbs which provide a mix of land uses and a high quality access system using walking and bicycle pathways to link land use with transit service. The guidelines address all levels of the planning and design process including overall planning issues, such as the location and designation of transit corridors, to individual site decisions, such as pedestrian access to buildings.

Marketing considerations are critical to the success of any development project. The guidelines also include the features, amenities, identity, recreational uses and services necessary to attract users to these communities. They are meant to be used by developers and planners for the design of attractive communities that can readily accommodate transit services.

¹Rabinowitz, Beimborn, Mrotek, Yan and Gugliotta, "The New Suburb: Analysis and Trends," prepared for Office of University Research, Urban Mass Transportation Administration, June, 1991.

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This report was developed by a team with engineering, architectural, real estate, planning and geography backgrounds. Information was gathered from a large number of sources including guidelines issued by transit agencies, land use zoning ordinances developed in Loudoun County, Virginia; Montgomery County, Maryland; Sacramento, California and Kitchener, Ontario; and other technical sources; a complete bibliography for the entire project is provided as part of this report. In addition several site visits were made and interviews conducted with planners involved in this area. Our review of entries to the International City Design Competition and of exemplary development projects, outlined in the New Suburbs report, provided a useful way to formulate the ideas and concepts that are in this report as did the guidelines developed in our previous study dealing with transit station design.²

²Rabinowitz, Beimborn, Lindquist and Oppen, "Market-Based Transit Facility Design."

PRINCIPLES

B. Principles

"The driving force in decisions regarding planning, location, design, frequency, operation and maintenance of public transit should be to respond to customer needs."



Elements of Successful Transit

Though the development of the suburbs were originally based on access to the central city by transit and subsequent suburban growth was transit-based for more than half a century, currently the provision and quality of transit in the suburbs is limited, with some notable exceptions. However, transit has been, and can again be, an attractive alternative to the car. To be successful, it must compete with the automobile in terms of access, convenience, comfort, and feasibility. The guidelines developed in this study and the requirements for a viable suburb which includes transit are based on the following principles:

1) **Market Orientation.** Transit services should be operated from a market based, user-oriented point of view. The driving force in decisions regarding the planning, location, design, frequency, operation and maintenance of public transit should be to respond to customer needs. Transit can be successful in attracting a significant number of users from the automobile if it provides a user-oriented service. User-oriented transit operates directly between passengers' origins and destinations without transfer, on a convenient schedule, in an attractive setting and at a price which is competitive with the automobile. Transit stops should be easily accessible to building entrances to minimize walking and there should be clear pathways that connect activity centers and transit services. Transit services should also provide a high level of amenities and services and clean, attractive vehicles where passengers feel a sense of security, comfort, and safety. Under such conditions, and with the use of appropriate land use patterns, transit will be successful and limit reliance on the automobile.

PRINCIPLES

"All transit trips begin as pedestrian trips and end as pedestrian trips. Pathways should be provided which minimize distances to points of activity . . ."

2) A Land Use Pattern with Concentrated Trip Ends. There needs to be a concentration of trip ends along the transit service. Appropriate land uses generate and attract trips. Those activities which most relate to transit should be located as closely as possible to transit stops. Furthermore they should be concentrated to create a number of high volume destinations in order to support a high level of transit service.

3) A Quality Access System. Access to public transit by pedestrians, bicyclists and automobile users should be convenient, safe and direct. All transit trips begin as pedestrian trips and end as pedestrian trips. Pathways should be provided which minimize distances to points of activity, provide attractive waiting environments and incorporate other land uses and services that support pedestrians and bicyclists.

4) Transit-Oriented Streets. Street systems should be laid out to facilitate efficient transit operations. Streets which have transit service should be free of sharp curves or steep grades and through routing should be provided with no need for backtracking or circuitous routing. Transit service should directly connect activity centers; there should be no need for shuttle services which connect activity centers to primary transit lines. Geometric design criteria for transit routing should provide for adequate stopping areas, safe pedestrian crossings and proper visibility. Automobile traffic should be restricted if necessary, to assure that transit vehicles do not experience delays.

Criteria for Transit-Sensitive Design

As part of our analysis of innovative suburban developments and of entries to the International City Design Competition (ICDC), both of which are reported in the first report of this project, we developed a set of criteria which can be used to analyze the compatibility between transit and land use. These criteria relate to land use, i.e., concentrations of trip ends, pedestrian movement, the ease of operation of the transit service and marketability. They are as follows:

Land Use Criteria

- A. **Size of Population:** Are the total number of people who live and/or work within the market area of a transit stop or route sufficient for transit service?
- B. **Density of Land Use:** Is the residential and/or working population concentrated enough to provide a market for transit services?
- C. **Concentrated Locations:** Are the locations of land uses concentrated in relationship to potential transit stops?
- D. **Mix of Uses:** Is there a mix of uses present to minimize travel to frequently used functions?

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Access Criteria

- A. Pedestrian Circulation: Are pedestrian paths short, direct, clear and interesting?
- B. Minimize Walking: Does the design provide logical pathways which connect land uses with the location of potential transit services so that overall walking distance is minimized?
- C. Safe and Secure Bicycle Access: Does the design permit safe travel to transit stops by bicycle and secure storage during travel?

Transit Operations Criteria

- A. Through Routing: Does the location of streets permit easy movement of transit vehicles into and out of the area without backtracking or circuitous routing?
- B. Turns Required: How many turns are required for transit vehicles to serve the area? Fewer turns are preferred.
- C. Right-of-Way Available: Are rights-of-way provided (either streets or guideways) that can be used for transit operations?

Marketability

- A. Identity: Do the communities and areas have a clear and distinct identity? Do the transit stops reflect that identity?

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- B. Amenities: How can amenities be provided to create an attractive living environment as well as be compatible with the high densities required for transit service?
- C. Design: Does the design provide a sense of place and character to which a broad range of potential residents will respond?

Quantitative measures of the criteria also could be developed. Land use activity could be measured by the trip density (trips/acre) within the service area of a transit stop (1/4 mile radius). This would be the product of residential density and trip rate for residential areas. The use of transit trip generation rates for different land use categories, such as are provided for vehicle trips in the *ITE Trip Generation Manual*, would provide the transit trip density within the service area of a stop. Unfortunately little data of this sort exists. Rates of capture for transit trips vary widely and depend not only on land use type but on the quality of transit service and household constraints and activity patterns.

Access can be quantified by looking at the area or housing units covered within an appropriate walking distance (1/4 mile). Directness of path can be found by comparing actual walking distances to a straight line ("as the crow flies") path. Safety, security and amenities of the access system cannot be easily quantified; they relate to the openness of pathways and the features that they have. Transit service compatibility could be measured in a similar way to access with a ratio of route length to direct length. Some indication of curvature of the route (turns required) would also be needed.

C. Transit-Oriented Land Uses

Land uses serve diverse needs and have different transportation requirements. Certain land uses -- multifamily housing, office buildings, educational institutions, etc. -- are highly oriented to transit use. These uses have a concentration of demand, a regular trip pattern and little need to carry large parcels. Other land uses -- lumber yards, garden centers, drive-through restaurants, etc. -- are totally oriented to the automobile; it is difficult to imagine any circumstances where people would use public transit on a regular basis to visit such places. Accordingly, if land use patterns are to be modified to better relate to public transit, it is important to understand which land uses should be included in an area served by transit and which should be located elsewhere.

" . . . it is important to understand which land uses should be included in an area served by transit and which should be located elsewhere."

An analysis was made of various land use categories to rate them for their compatibility with public transit. Land use categories from the ITE Trip Generation Manual, 4th edition were used. This manual provides trip rates for 74 different land use categories and is frequently used by traffic engineers to forecast local effects of development on highway traffic. In all but a few categories rates of auto vehicle trips are given as a means to forecast the impacts of various land uses on traffic. Only in a few cases are rates of transit trip making given. Nonetheless, the land use categories and trip rates are useful in that they can help separate land uses by their compatibility with transit. A compatibility rating was determined for each ITE trip category using a 1 to 5 scale with 5 representing a high compatibility with transit and 1 representing a low compatibility. This was done by evaluating the following criteria for each land use: the frequency of regular travel to these places; typical sizes; and whether or not there is a need to carry large parcels. In addition, land use categories were also judged by their peaking characteristics, and type of potential users. Detailed results of this analysis are given in Appendix A.

TRANSIT ORIENTED LAND USES

The following land use categories were judged to have high transit compatibility (ratings of 4 or 5) and should be located in areas to be served by transit.

Commercial Airport
Park and Ride Station
General Heavy Industrial
Apartments
Residential Condominiums
High Density Residential
Retirement Community
Hotel -- non-CBD
Stadium
Elementary School
High School
Junior/Community College
University
Hospital
General Office Building
Office Park
Shopping Center

Those land uses which were rated 2 or 3 have a low to medium orientation to transit and can generally be separated from transit in preference to category 4 or 5 land uses.

TRANSIT ORIENTED LAND USES

The following had low compatibility (a rating of 1) and it is unlikely that large numbers of people would use transit to get to these places on a regular basis. These land uses can well be separated from public transit services.

Water Port
General Aviation Airport
Truck Terminal
Mini-Warehousing
Utilities
Recreational Homes
Resort Hotel
Marina
Golf Course
Day Care Center
Nursing Home
State Motor Vehicle Department
Building Materials and Lumber
Hardware/Paint Store
Nursery/Garden Center
Quality Restaurant
New Car Sales
Service Station
Car Wash
Highway Oasis
Truck Stop
Furniture Store
Drive-in Bank
Drive-in Savings and Loan

CONCEPTUAL DESIGN

D. Conceptual Design

A major goal in the project was to develop a conceptual framework for the design of transit-sensitive suburban areas. This effort was based on our reviews of the literature and an analysis of ICDC entries and the exemplary designs as outlined in *The New Suburbs* report. These projects, which are in various stages of the implementation process, indicate an incipient new direction in suburban planning and design which can lead to a new generation of suburban development. Though none of the designs we examined incorporates all the elements of a transit-sensitive suburb, taken together they provide a variety of concepts and features which could be the basis for such projects.

"The land use plan should have at its core a mix of uses and a pedestrian orientation which will encourage walking and bicycle use . . ."

The principles behind the guidelines in this report are the integration of transit and land use planning to provide the features and services necessary to create a genuine and workable community. The following four factors form the basis of this planning.

Land Use Design. The suburban community must be planned to be an attractive and viable place to live and work as well as dealing with issues related to the provision of transit. The land use plan should have at its core a mix of uses and a pedestrian orientation which will encourage walking and bicycle use and reduce the use of the automobile. In addition the location of uses, streets and parking should support transit services. Part of the land use plan is the preservation of land in natural and agricultural areas which will also reinforce the milieu of the developments.

Access Systems. Access is the literal link between transit and land use. Transit stops should be located in relationship to the placement and density of population, employment centers and other destinations. Links and pathways between the transit stops and these destinations should be provided to insure that the transit-related goals of the project will be met.

CONCEPTUAL DESIGN

Transit Services. Transit is at the core of planning for this community, with a reduced reliance on use of the automobile. The provision of high quality public transit system, responsive to market needs, provides an opportunity for the residents or employees in one of these communities to use transit in lieu of the automobile. Transit should be easily accessible to almost all residents and we expect significant portion of the population to use transit.

Market. The project must function as a community. The design should provide features, amenities, design and services which will make an attractive place to live. Market considerations also includes the provision of a number of types of housing to attract a diverse market, demographically as well as in terms of economics, as well as a market which will use transit more frequently. Transit services should be market oriented in that the needs of users should be the driving force in the design and operation of services.

"Transit is at the core of planning for this community, with a reduced reliance on use of the automobile."

Based on these factors, a conceptual design was developed that separates transit- and auto-oriented land uses and calls for the creation of Transit Corridor Districts (TCDs) where public transit, walking and bicycles are to play a major role in providing mobility. Transit Corridor Districts would serve as prime locations of transit-oriented land uses and as a means of creating an environment where mobility is provided by non-automotive means. Transit corridors within these districts would ideally be separated from arterial highway corridors by a distance of at least 1/4 to 1/2 mile. These corridors would be protected through zoning actions and by the careful placement of periodic closures to non-transit traffic -- to avoid excessive automobile usage. Technological flexibility should be provided for in the design of transit corridor districts. Corridors for transit would likely be operated with buses at early stages of development, but they should be designed to be easily upgraded to light rail transit or other technological options. The critical feature is that there is

CONCEPTUAL DESIGN

a concentrated land use pattern and pedestrian/bicycle access system that supports transit and is served by transit.

" . . . a concentrated land use pattern and pedestrian/bicycle access system that supports transit and is served by transit."

Separation of transit service from conventional auto-oriented arterials is attractive since conventional arterials in the suburbs are seldom suited to transit service. Suburban arterials are typically lined with strip commercial developments which are normally set far back from the roadway, and have little if any pedestrian facilities that can connect them to transit. Land uses along suburban arterials are also often inappropriate for transit use. Auto oriented uses such as lumber yards, garden centers, drive-in banks, fast food drive-through restaurants, funeral homes, and the like, which predominate along suburban arterials are intermixed with land uses that related to transit. On the other hand, those land uses which relate strongly to transit such as housing, office buildings, educational facilities, retail buildings and factories are often separated from the arterials which have the transit service. Thus the separation of transit and arterial routes and the location of appropriate land uses proximate to each of these modes creates a more efficient and convenient overall system.

Transit service which is not located next to arterial routes faces a different problem. Typical suburban streets often follow a curvilinear pattern with little opportunity for through routing. In addition, adjoining subdivisions may well have non-aligned streets or complete boundary separations. In this situation transit vehicles are required to make frequent turns and may need to 'backtrack' in order to provide service within a reasonable distance of homes or places of work. This results in lower operating speeds, additional noise and pollution as vehicles negotiate their way through a maze of suburban streets. Lower speeds and indirect routing also result in a lower level of service relative to the automobile and, in turn, lower levels of demand. In addition, operation in suburban residential areas can result in complaints

CONCEPTUAL DESIGN

by residents because of noise, emissions and increased traffic. These factors, combined with a lower density of land use, lead to poor prospects for transit services located in suburban areas.

Based on the principles and criteria described earlier, we propose a separation of transit and automobile oriented land uses and the creation of separate transit corridors located parallel to, and 1/4 to 3/4 mile from, highway arterials. Such transit corridors would feature a central street that could be used for through movement by transit vehicles and for local automobile traffic. However there would be control of through auto traffic by periodic street closures or other devices. Transit corridors would be predesignated in advance of development and protected through the creation of Transit Corridor District (TCD) zoning. These corridors would be planned to anticipate various transit modes. Flexibility would also be provided within developments, including having a mix of land uses with density gradients away from the transit corridor. Transit corridor districts would also include pathway systems for bicycles and pedestrians, and a mixed, high density land use.

"Transit corridors would be predesignated in advance of development and protected through the creation of Transit Corridor District (TCD) zoning."

Part of the Transit District Corridor zoning would designate locations for activity centers where stops would be located. These centers, which would contain a mix of such uses and high levels of activity, would be the focus of individual neighborhoods, developed by various organizations, but all based on zoning which both creates an attractive community as well as a feasible public transit system.

These designated Transit Corridor Districts will capture much of metropolitan growth for some time. Areas between districts will either be preserved as agriculture and natural areas or contain low density uses. Through using only a portion of the land surrounding the central city for development the environmental quality of open and rural space is preserved.

CONCEPTUAL DESIGN

Corridor versus Node Based Systems.

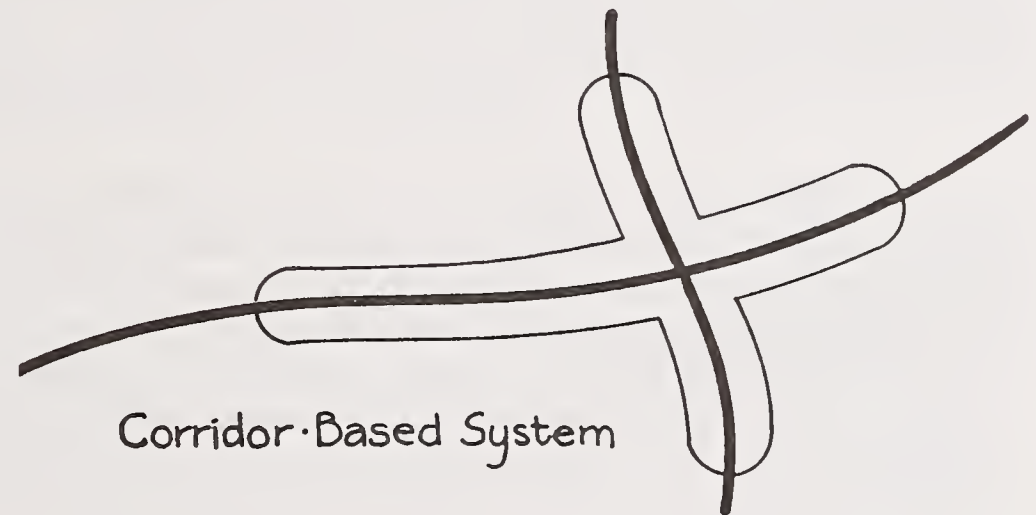
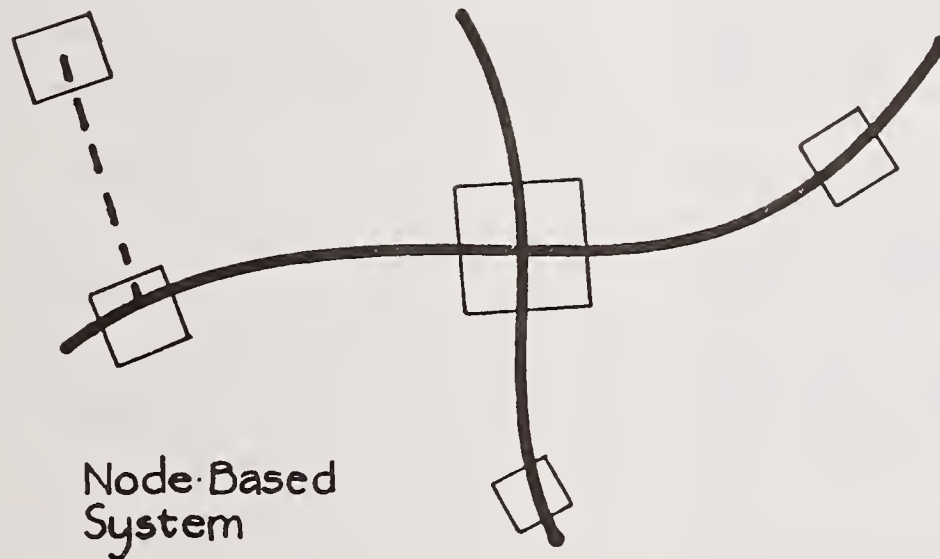
Two conceptual approaches exist for land use planning in relationship to transit. These are a corridor based or a node based approach. Both techniques significantly improve the potential for expanded transit service and result in less dependency on the private automobile. A node based system generally assumes a central terminal or station which is reached by radiating pathways (see Laguna West in report number one as an example of this concept). Such a system is most appropriate when stops are widely separated along the transit route. The overall pattern of land uses then resembles a string of beads along primary transit routes. Such patterns are found historically on commuter rail lines radiating from older central cities. These systems have traditionally been used for commutation to the central city and have very few trips between the outlying stations.

Another approach is to use closer stop spacing and to provide more of a corridor-based system. In this system land use patterns look more like a string of sausages along the primary transit route. Station service areas overlap and it is possible to walk or bicycle to several stops from any one location.

Both approaches have significant advantages over conventional land use patterns because they concentrate demand near stops and provide good accessibility for transit. Our approach is to emphasize a corridor-based approach. Projects using this approach have been limited and a corridor-based approach results in efficiencies of scale, size and length of route as well as contending with political realities which often limits the scale of an overall transit system. Corridor-oriented systems can also lend themselves to evolutionary development of both transportation technology and land use changes. In addition, they may have a greater potential for intrasuburban

CONCEPTUAL DESIGN

travel and for expanded pedestrian/bicycle travel. Many of the guidelines in this report relate to both concepts and could be adapted to either a node based or corridor based design.



ORGANIZATION OF GUIDELINES

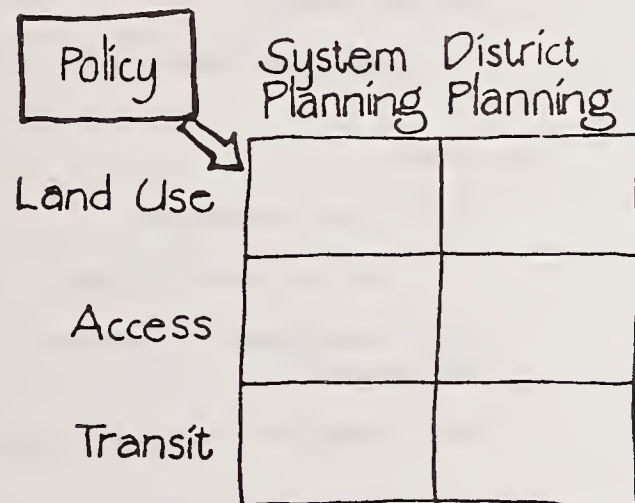
ORGANIZATION OF GUIDELINES

PART II: GUIDELINES

E. Organization of the Guidelines

The basic approach in this study was to create development patterns that follow corridors and occur as linear extensions of urbanized areas. Transit routes will operate most effectively in a linear pattern with very few turns. These overlapping demands of market forces and transit engineering provide a natural situation for the development of organized transit corridors.

A few transit systems have developed guidelines for land use design. Most of these guidelines tend to focus on the individual site. This report furthers that concept by incorporating the present array of specific site design rules into a comprehensive set of guidelines that addresses transit on a systems level.



There are three major guideline categories: (1) Administration and Policy, (2) Systems Planning, and (3) guidelines related to the Design of the Transit Corridor Districts. While there is some overlap to these categories, guidelines are organized in this sequence. The systems planning and district planning guidelines each have three parts: land use, access to transit, and transit operations guidelines. Systems planning deals with the overall location of transit corridor districts, access to public transit and general rules for the operation of transit services. District level planning relate to the way in which land uses are arranged within a transit corridor district, how access is provided and how transit services are accommodated. Policy guidelines are not site specific and relate to how things are implemented, who has input in the process and how services and areas are managed. The guidelines that are provided are shown in Table 1.

ORGANIZATION OF GUIDELINES

Table 1: Transit Sensitive Land Use Design Guidelines

Administration and Policy Guidelines

Modify state and local policies to include transit as an element of land development (23).

Zoning should encourage transit-sensitive land use design through the designation of Transit Corridor Districts (TCDs) (24).

Provide for transit-sensitive review of site plans and development proposals (26).

Provide transit checklist for potential developers (28).

Parking requirements in TCDs should reflect availability of transit services (30).

Establish a Transportation Management Association to oversee transportation services and land use development along the transit corridor (31).

Provide a mechanism for transfer of development rights (TDRs) for the land surrounding the TCDs (32).

System Planning Guidelines

Land Use Design

Predesignate a future system of transit corridors (35).

Separate transit-oriented and auto-oriented land uses (39).

Establish transit service zones along existing arterials (40).

Explore public/private opportunities for transit stop joint development (41).

Provide adequate population size and density to support transit use (42).

Design for a phase implementation of transit corridors (47).

Access Systems

Control of through automobile traffic (49).

Use corridor for primary pedestrian, bicycle and transit movement (51).

Avoid need for shuttle service (53).

Transit Services

Highway/transit relationship (55).

Provide high quality transit service (56).

Transit vehicles should be quiet and have low air pollution levels (57).

Identity: Signage and compatibility of stops (58).

ORGANIZATION OF GUIDELINES

Table 1: Transit Sensitive Land Use Design Guidelines (continued)

District Level Guidelines

Land Use Design

Designate type and location of transit (62).

Provide mixed land use including housing, office, retail, light industrial and recreational uses (66).

Relate design to market (68).

Provide variety within the district (69).

Land use density gradient (71).

Utilize appropriate land use adjacencies (72).

Provide recreational opportunities and amenities (73).

Accommodate multiple developers and development patterns (74).

Relate the design and connections of adjacent developments across 'seams' (75).

Parking density gradient (76).

Develop a program to encourage shared parking facilities (77).

Minimize the distance between building entrances and transit stops; provide logical connections between buildings and transit (79).

Building location and design should be sensitive to transit-generated noise and views (81).

Access Systems

Pedestrian/bicycle pathway system (83).

Provide for safe, convenient pedestrian circulation (85).

Promote bicycle access through high quality pathways and secure storage systems (87).

Provide for feeder bus and auto access points (88).

Transit Services

Technological and infrastructure flexibility (89).

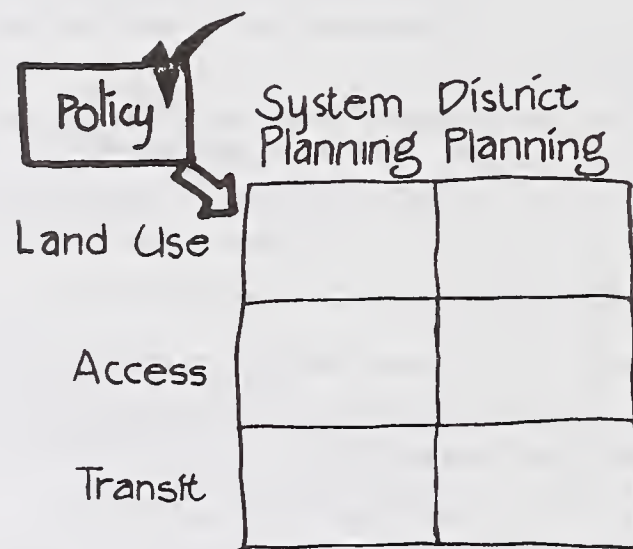
Provide for high level geometric design of transit corridors (91).

Provide for handicapped access (92).

Provide for passenger safety and security (93).

Provide regular maintenance at transit stops (94).

F. Administrative and Policy Guidelines



The first set of guidelines relate to administrative procedures and overall policy which should be established to create a better setting for the integration of land use and public transit. These guidelines call for transit agency involvement in the review of development proposals and project designs.

A second area discussed is the establishment of special zoning districts, called Transit Corridor Districts (TCDs), which concentrate travel demand along future transit corridors. Transit-oriented land uses should be located in the TCD, while other land uses would be generally located outside of the district. Changes in parking codes and procedures to manage a TCD are also provided.

ADMINISTRATIVE AND POLICY GUIDELINES

Modify state and local policies to include transit as an important element of land development.

"State statutes should require municipalities to consider transit and pedestrians in the development review process."

Traditionally, the only government agency concerned with transit issues (excluding funding) has been the local transit agency itself. However, most development decisions in a metropolitan region are made by municipalities that have little or no involvement with transit service. While these guidelines are designed for the integration of transit consideration into local development decisions, this is problematical without the state's role in the encouragement of transit usage.

State statutes lay the groundwork for the operations of all municipalities. State statutes can provide the impetus for all municipalities to consider transit planning. The state should modify sections of the statutes that discuss the development of land or zoning to acknowledge the inherent relationship between land use and transportation. In more specific sections the statutes should require municipalities to consider transit and pedestrians in the development review process.³

³Delcan Corp., "Guide to Transit Considerations in the Suburban Design and Approval Process, p. C-2.

ADMINISTRATIVE AND POLICY GUIDELINES

Zoning should encourage transit-sensitive land use design through the designation of Transit Corridor Districts (TCDs).

The local zoning ordinance is the primary tool used to implement land use policy. Unfortunately transit issues are seldom addressed in contemporary zoning ordinances. The local zoning ordinance should be updated to include the consideration of transit throughout all relevant sections. The inclusion of transit in the code will provide a regulatory basis for the enforcement of the guidelines in this report. While some guidelines involve general concepts, others will need to be specifically added to the zoning ordinance. Detailed transit regulations should be incorporated in the zoning code for Transit Corridor Districts (TCDs).

"Transit Corridor Districts would provide a specially zoned area that is especially responsive to the use of transit."

Additions to the existing zoning ordinance will improve a municipality's efforts to encourage transit, however, conventional zoning districts can still provide inadequate regulation of development in areas with a potential for high transit use. Transit Corridor Districts would provide a specially zoned area that is especially responsive to the use of transit. A TCD would permit much greater regulation of transit-related concerns in primary service areas while allowing the conventional zoning code to govern development in other areas. All land falling within a TCD would be subject to guidelines similar to those outlined in this report. Property outside of a TCD could be subject to some of the same concepts found within the guidelines, especially those concerning individual site design, but traditional zoning techniques would be utilized.

The review process for proposed projects in a TCD would be much like the review process for planned unit development used by many municipalities. The TCD would expand upon the concept to a 'Transit Overlay Zone' used in the Portland, Oregon area that focusses on the mixture and density of developments near light rail stations.

ADMINISTRATIVE AND POLICY GUIDELINES

Transit districts of ten to eleven acres in size were created at light rail stations for high density residential and office development.⁴ Another example are the many historic districts zoning ordinances created to preserve the history of many older downtowns.

Transit Corridor Districts may be areas along existing arterial streets or could anticipate the location of new roadways/corridors for future transit-oriented development. The selection depends upon local constraints of existing development and other physical, operational and political factors.

⁴Seattle Metro, "Encouraging Public Transit Through Land Use Actions," p. 95, Snohomish County, "Guide . . .," p. 5-13.

ADMINISTRATIVE AND POLICY GUIDELINES

Provide for transit-sensitive review of site plans and development proposals.

A major obstacle to providing efficient transit service is the lack of analysis of transit factors in the site plan review process. Traditional site design planning practices are contradictory to efficient transit service and municipal staff are usually not familiar with the concept of transit sensitivity. If staff cannot effectively include transit in the site review process, then the local transit agency can be involved in this process.

Transit agency review should be included for many types of development proposals in a community.⁵ Guidelines would be made part of the Transit Corridor Districts and transit agency review would be a part of this approval process. Other suburban locations should also be reviewed based on a lower standard of transit operations.

"Transit agency review should normally be included for all development proposals in a community."

This additional step in the development approval process requires cooperation between transit agencies and municipalities but the results will benefit both the municipality in terms of less review effort and the transit agency in better site designs. Another benefit is that comments on site design can remain consistent through the region. This consistency will benefit developers as well as the transit agency and municipalities.

The incorporation of transit route planning early in the land use decision making process will, in most cases, ensure that walking distances to transit are kept to acceptable levels. Community planning and road system design should also provide for the incremental extension of transit routes without the need to restructure or substantially revise existing service.

⁵Snohomish County, "Guide . . .," chapter 9.

ADMINISTRATIVE AND POLICY GUIDELINES

The following guidelines may be useful in planning a street network which can be efficiently served by public transit:

- Design arterials and transit services in advance of development, to connect clusters.
- Encourage neighborhood and service area designs that minimize street lengths and the percentage of area devoted to streets.
- Apply suitable roadway geometries to accommodate bus turning maneuvers.
- Ensure that streets identified for possible transit usage be structurally capable of supporting the weight of transit vehicles.
- Pedestrian pathways should be provided on streets carrying transit. Sidewalks and an attractive pedestrian environment are particularly necessary on collector and arterial roads.
- Bicycle access to transit centers, park-and-ride lots, freeway flyer stops, and other major bus stops should be encouraged by local jurisdictions. Wide curb lanes (13 feet minimum) or striped bike lanes should be considered for major streets leading to transit facilities.⁶

⁶Seattle Metro Transit, "Encouraging Public Transportation Through Effective Land Use Actions," p. 41.

ADMINISTRATIVE AND POLICY GUIDELINES

Provide transit checklist for potential developers.

Local governments should work with transit agencies to create a checklist that can be used by real estate developers and their consultants during the site design stage. The checklist should be a condensed version of the guidelines. This is an opportunity for the municipality to minimize plan review time by showing the developer what is preferred before any plans are drawn. A sample of such a checklist as developed by the PACE Suburban Bus Service in Illinois is shown on Table 2.

ADMINISTRATIVE AND POLICY GUIDELINES

Table 2. CHECKLIST FOR TRANSIT AGENCY REVIEW OF DEVELOPMENT PROJECTS

The Transit Checklist can be used to evaluate the accessibility of a development to public transportation. Development plans can be critiqued by answering the questions on the checklist. These questions are designed to receive a "Yes" response if the development will accommodate transit vehicles and provides access to public transportation. If a "Yes" response is not received, refer to the appropriate chapter in the Guidelines for design suggestions. If further assistance is required, PACE will review development plans and provide transit-related design suggestions and technical assistance.

*Do the roads within and around the development incorporate the following features to make the development accessible by public transportation?

- * Intersection radii for driveways and intersections designed for a 52.5-foot outside turning radius.
- * Roadway grades that are 3% or less.
- * Roadway pavement should be constructed to handle vehicles with loads of 20,000 lbs. per axle.
- * Bus loading pads should be designed with a minimum 8" portland cement concrete jointed reinforced pavement and a 4" subbase of stabilized granular material.
- * Lane widths of 12 feet.
- * Curb heights of 6 inches.

*Are residential developments designed with a central collector street that provides access for transit vehicles?

*Have bus stop locations near the development been identified by PACE?

*Are paved passenger waiting areas provided at all near-side corners of collector and arterial street intersections?

*Are passenger amenities (shelters, benches, adequate lighting, bicycle storage facilities, and landscaping) provided at bus stops?

*Are transit stops located within one-quarter mile (one-half mile in low density developments) or less of all buildings within the development?

*Have bus turnouts, berths, turnarounds and/or park-n-ride facilities been incorporated into appropriate roadway or development designs?

*Do pedestrian walkways provide a direct path from building entrances to transit stops?

*Are pedestrian walkways and bicycle routes located along the development's perimeter streets? Do they lead directly to building entrances?

*Are walkways, curbs, bus stops, building entrances, parking areas and transit facilities designed for the mobility limited?

*Do office and industrial developments over 25,000 square feet have lobbies designed with passenger waiting areas?

*Are retail, office and industrial buildings located within 150 feet from transit service?

*Is adequate lighting provided at bus stops, passenger waiting areas and along pedestrian walkways?

*Are 5% of the parking spaces near the primary building entrance from the parking lot designed for vanpool/carpool vehicles?

*Do parking spaces for the mobility limited conform in dimension and number to the Illinois Accessibility Code?

*Are parking spaces for the mobility limited located adjacent to the primary building entrance from the parking lot?

Source: PACE Development Guidelines, PACE Suburban Transit System, Arlington Heights, Illinois.

ADMINISTRATIVE AND POLICY GUIDELINES

Parking requirements in TCDs should reflect availability of transit services.

The amount of parking required in a transit corridor district will be based on accessibility to transit as well as the traditional needs of different building types. The number of parking spaces will be limited along main transit corridors. Properties immediately accessible to transit stops will have the fewest number of parking spaces.⁷ This will encourage greater use of the transit system as well as allow for a higher development density near the stops.

Developments located closer to auto arterials will have traditional parking ratios to allow for a higher level of auto use. Larger parking lots should be provided for land uses that are primarily served by the automobile. These developments will be separated from the transit service. Although transit may not seem likely in these areas, the locations of buildings and parking areas may still be designed to accommodate service if it becomes necessary in the future.

In addition, innovative concepts such as joint parking should be encouraged. This type of arrangement minimizes parking areas by locating building types which use parking at different times adjacent to each other. Churches adjacent to office buildings and movie theaters are examples of such shared arrangements.

⁷Snohomish County, "Guide . . .," p. 3-7.

ADMINISTRATIVE AND POLICY GUIDELINES

Establish a Transportation Management Association to oversee transportation services and land use development along the transit corridor.

A Transportation Management Association (TMA) is a coalition of local businesses and other concerned parties that develops goals and appropriate strategies involving the improvement of transportation within a particular area. Transportation Management Associations are a recent phenomenon that have become important in mitigating traffic problems in impacted urban and suburban areas.⁸

These associations provide a regional or subregional coordination of transportation activities by participants who have a vested interest in convenient access to the impacted area. Local business leaders can often implement such changes more efficiently than government agencies.

Because the transportation system provides the armature for development within a TCD, the establishment of a Transportation Management Association should be strongly considered. A TMA not only provides a means of coordinating transportation facilities within the district but it also gives individual property owners some voice in transportation decision making.

"A TMA not only provides a means of coordinating transportation facilities within the district but it also gives individual property owners some voice in transportation decision making."

⁸Snohomish County, "Guide . . .," p. 6-2.

ADMINISTRATIVE AND POLICY GUIDELINES

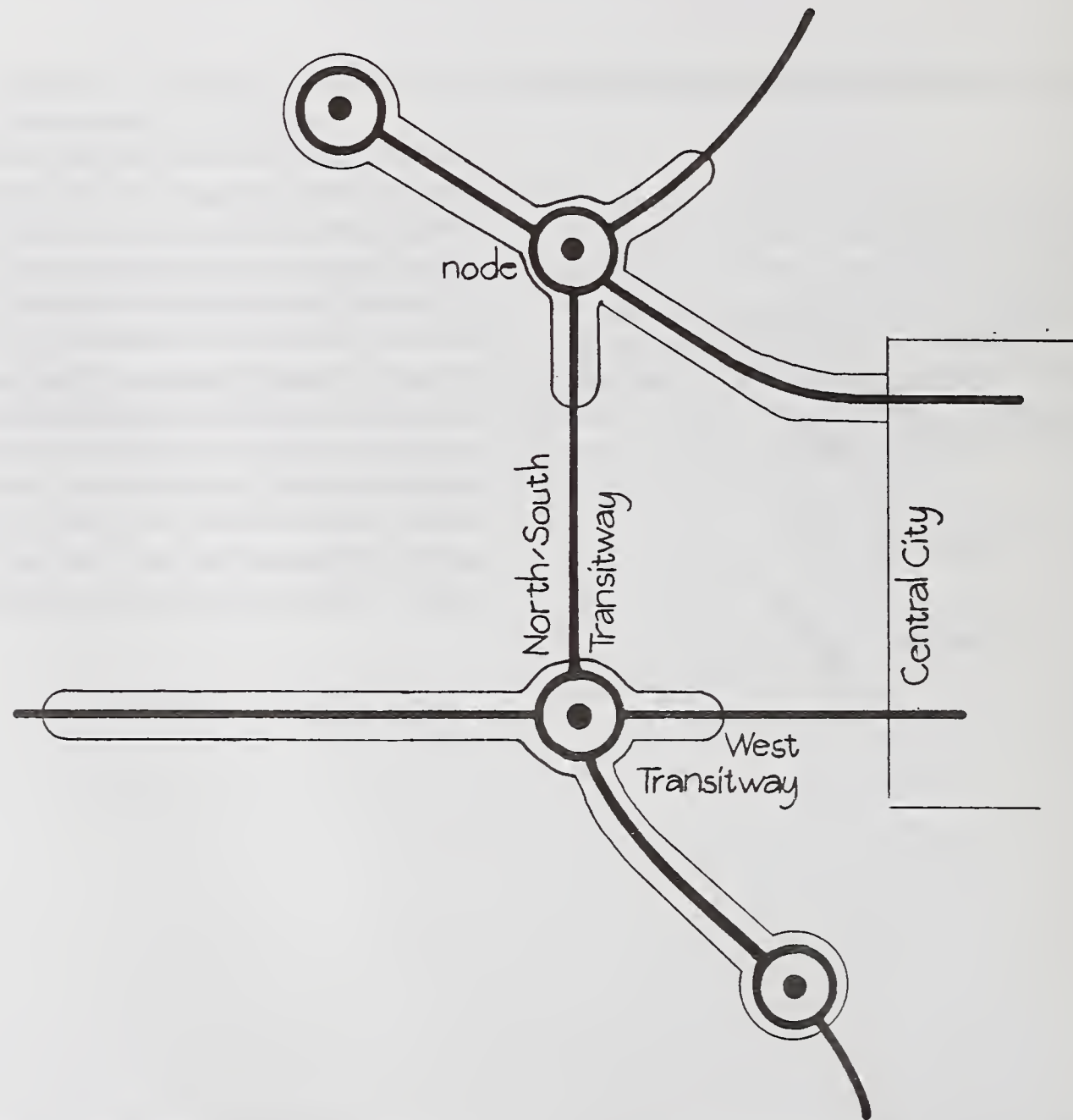
Provide a mechanism for the transfer of development rights (TDRs) for the land surrounding the TCDs.

In order to ameliorate the disparity in land values created by the designation of a TCD, landowners in the surrounding areas should be able to transfer development rights to the district. By purchasing these rights, or increased floor area ratios, needed for development in the district from surrounding landowners a measure of equity is achieved as well as reduced political opposition to the TCD location. The transfer of development rights benefits the transit service by allowing private developers to concentrate dense development closer to transit stops. At the same time, outlying areas are left low densities and free from auto congestion.

G. Systems Planning Guidelines

	System Planning	District Planning
Policy		
Land Use	✓	
Access	✓	
Transit	✓	

Overall transit systems planning decisions need to be made to establish a transit-sensitive land use pattern. These decisions occur at a larger scale than an individual Transit Corridor District, generally at a metropolitan or regional scale. They are general guides which relate to overall locations of corridors and their basic structure. Guidelines for these decisions are given in the three categories which are essential to successful transit in the suburbs. These are Land Use, Access Systems and Transit Services. Systems planning guidelines for land use include the need to locate and designate transit corridor districts and/or transit service zones along arterials early enough so that a separation of auto- and transit-oriented land uses can occur. Access guidelines relate to the need to explicitly plan for pedestrian and bicycle access to transit and to control automobile traffic to avoid excessive congestion. Transit service guidelines deal with the types of transit modes that could be accommodated, vehicle design and operational patterns.



SYSTEMS PLANNING/LAND USE

Predesignate a future system of transit corridors.

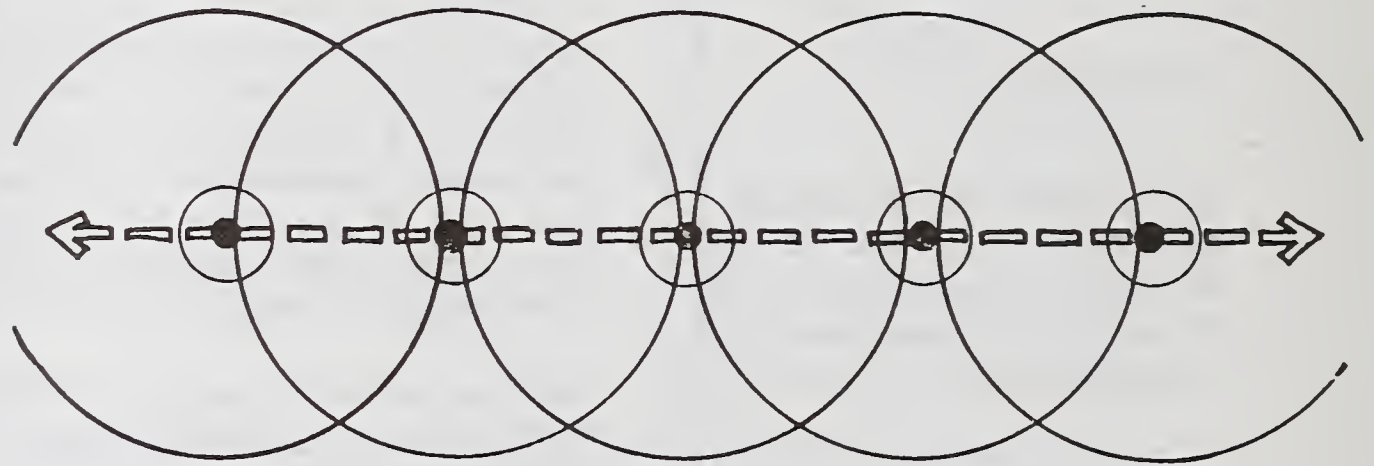
A transit-sensitive solution to land use in the suburbs must be part of an overall metropolitan or regional transportation plan. A transportation corridor must be linked to heavily concentrated locations, such as the central business district or existing major employment and/or activity centers.

An important element in making the concept feasible is to predesignate corridors for transit service and for the location of transit-oriented land uses. Early location and designation of the corridor is essential so that subsequent land use decisions can be made with a commitment to future transportation services. This will enable communities to separate auto-oriented land uses from transit-oriented land uses and to locate them in relation to the proper mode. Failure to do so will result in an inappropriate levels of density, a separation of trip generators, and poor pedestrian access that would likely minimize the chances of successful transit services.

"Early location and designation of the corridor is essential so that subsequent land use decisions can be made with an understanding of future transportation services."

Transit-sensitive districts can be ideally accomplished by a physical separation of transit services from primary auto-oriented arterials. Transit services should be at least 1/4 mile away from the parallel arterial and should provide opportunities, through zoning, for development of land uses, population sizes and densities that relate to transit. The corridor could be located along an existing roadway or a proposed new roadway.

A transit corridor independent of a highway arterial would provide a full transit service area independent of the highway arterial -- walking distances to transit would then be limited to 1/4 mile and transit-oriented land uses should be within this distance to provide pedestrian access to transit services. A transit stop spacing of



TRANSIT STOPS ARE LOCATED EVERY $\frac{1}{2}$ - $\frac{1}{4}$ MILE ALONG
THE TRANSIT LINE FOR EASY ACCESS.

SYSTEMS PLANNING/LAND USE

approximately 1/4 mile would provide good accessibility along the corridor itself where the most concentrated land uses would be located.

It is vital to establish the basic Transit Corridor District locations prior to most development activity. The most effective corridors will be initiated in undeveloped areas. The success of the corridor relies on the ability to integrate a pattern of land uses that are compatible with transit, as well as the internal design of each individual site. The use of transit-sensitive design guidelines from the beginning of the development process can accelerate corridor success.

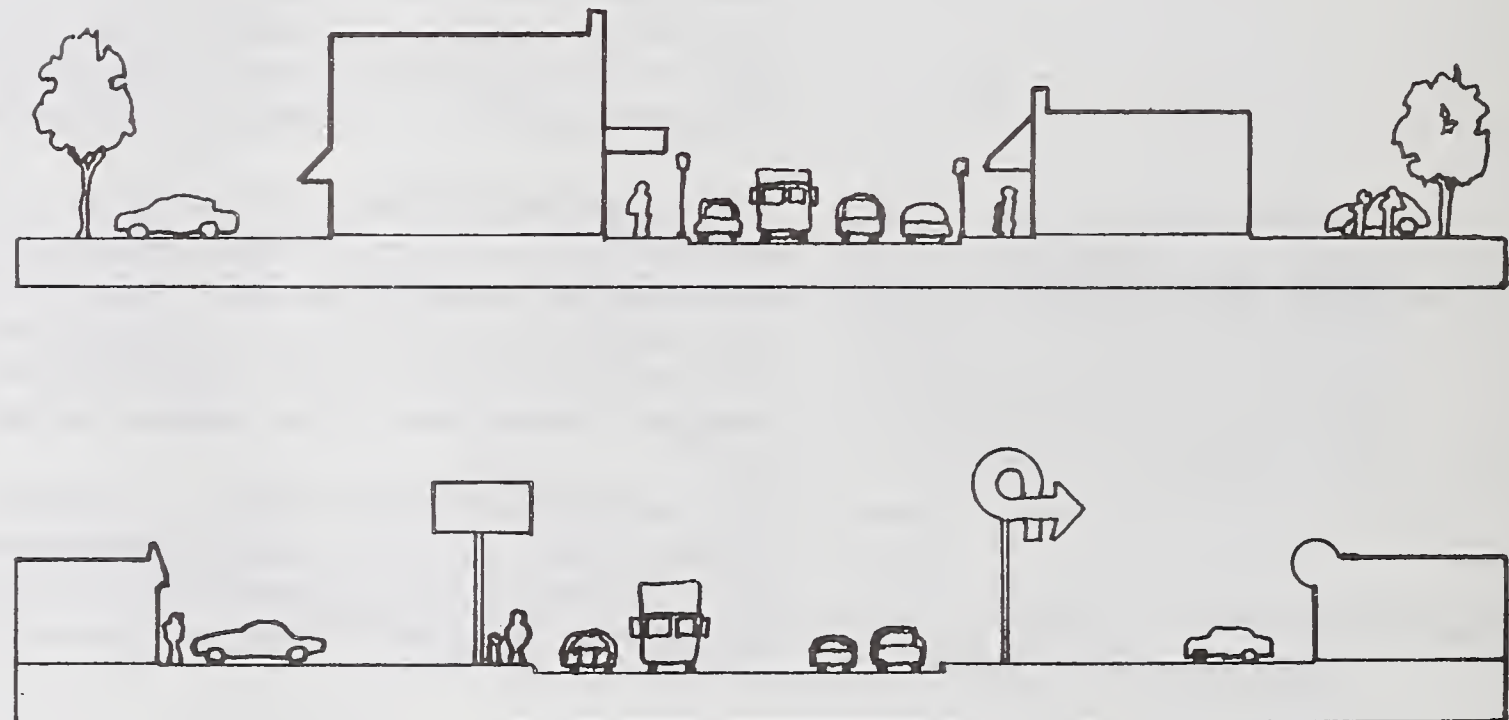
"The success of the corridor relies on the ability to integrate a pattern of land uses that are compatible with transit, as well as the internal design of each individual site."

Where ideal transit corridor locations contain some development, reasonable efforts should be made to incorporate existing land uses into the development of a transit corridor. This concept is especially important because finding large corridors of completely undeveloped land that could sustain dense growth may be difficult. More often there will be some older, scattered developments present. Future uses of developed parcels should also be considered as land use demands change over time.

Early establishment of TCDs reflects a commitment from the government to future developers that a full service transit line will operate in a specific area. This will help to eliminate fears and speculations about the future of the corridor. Demand for land along the corridor should stabilize once the zoning is established.

SYSTEMS PLANNING/LAND USE

Transit-related development/automobile related development



Source: Snohomish County "Guide . . .," p. 8-7 from Portland "Public Streets for Public Use."

SYSTEMS PLANNING/LAND USE

Separate transit-oriented and auto-oriented land uses.

A key element in the design of transit-sensitive suburban land uses is to spatially separate activities which are highly related to the automobile from those which are related to public transit. Certain activities are distinctly auto-dependent -- it is difficult to perform them using transit. These are activities that require transporting large objects, that require multiple stops, or that take place in evenings or weekends. Examples include purchases at a lumberyard, collecting a group of children and taking them to a soccer practice, or going out for dinner and a movie. Activities conducive to the use of public transit include those that occur with some regularity and with a direct origin-destination pattern.

"A key element in the design of transit sensitive suburban land uses is to spatially separate activities which are highly related to the automobile from those which are related to public transit."

To maximize the potential for the use of public transit and to alleviate suburban traffic problems, we propose a separation of land uses based on their associated traffic modes. Ideally, parallel corridors would be developed, one primarily for the automobile and its associated land uses, and one for transit and its related land uses. Land uses oriented to the automobile -- car dealers, large package retail shopping, low density housing, motels, car-oriented food franchises, large plot outdoor recreation, etc. -- should be located along highway corridors. Land uses oriented to transit -- high density residential developments, office buildings, schools, facilities for the elderly and some retail -- should be located along a transit corridor. Within the corridor a mixture of building types and the proximity of building types would also encourage pedestrian access. Concentrated locations of educational facilities, office buildings, shopping and housing would reduce the amount of transportation required -- whether by auto or public transit.⁹

⁹See guide to auto/transit land use in Appendix A; also Snohomish County, "Guide . . .," p. 3-8.

Establish transit service zones along existing arterials.

Ideally there should be a physical separation of at least 1/4 mile between primary auto-oriented arterial streets and transit service corridors. This may not be possible for physical, political, or operational reasons. It may also be difficult because existing development blocks the path of a transit corridor. Many of the principles of these guidelines could still apply, however, if land use along existing arterials were more effectively managed. This could be done by designating TCDs along specific zones of arterial streets to create a linear separation of auto- and transit-oriented land uses. For example, there may be a two-mile long district with transit-related land uses and building setbacks where transit vehicles would make frequent stops followed by an area of auto-oriented land uses which transit vehicles would bypass without stopping. While this may not be as efficient as having separated roadways, it still provides advantages over current systems of suburban development.

SYSTEMS PLANNING/LAND USE

Explore public/private opportunities for transit stop joint development.

There is a symbiotic relationship between public transit and business activity. Transit provides quick, convenient access to commercial enterprises and customers and a market demand for business activities. Business activities and private developments generate trips on transit systems and help to support viable public transportation. Every transit stop should be viewed as an opportunity for joint development -- a place to link together public and private projects. The level of activity at a stop can vary from small, with the provision of newspaper boxes, public telephones, and a cash machine, to extensive retail and service areas serving both transit, employees and shoppers, with large multiple use projects directly tied into the transit systems.

"Every transit stop should be viewed as an opportunity for potential joint development as a place to link together public and private projects."

The convenience of retail, service and office uses at a stop enhances the attraction of using public transit and the transit in turn strengthens these commercial activities. Convenience uses such as cleaners, flower shops, shoe repair, VCR rental and automated money machines, as in many other transit locations, will be successful as neighborhood enterprises. These will be relying on the neighborhood customers with a strong contribution due to the station location. Other uses will also have a strong competitive advantage -- this includes shopping for staples on the trip home, including grocery, drug and liquor stores.¹⁰

Local government agencies and transit systems should work cooperatively with developers and private investors to seek out locations with good transit access for new development projects.

¹⁰Rabinowitz, Beimborn, Lindquist and Oppen, "Market Based Transit Facility Design."

Provide adequate population size and density to support transit use.

The density of trip ends at a transit stop is a critical element in determining if public transit has sufficient demand to justify its service. Both land use densities and the total population in the service area of a stop are important. Average residential densities of at least seven dwelling units per acre within the service area of a route are considered as the minimum level to justify the use of local bus routes with 30 minute headways, while densities of 15 dwelling units per acre are needed for 10 minute headways.¹¹ These values, however, can vary significantly based upon assumptions that are made concerning capture rates of transit, service frequency, average fares, subsidy rates, hours of operation, speeds, and average hourly costs. These terms can be derived from settling daily revenues on a transit route to be equal to daily costs for break-even operation. The following equation results:

$$\text{Transit trip density} = (\text{Cost recovery ratio} * \text{Service ratio})/160$$

Transit trip density is the number of daily transit trips per acre in the service area (within 1/4 mile) of a route. For a residential area this is the product of the residential density in dwelling units per acre times the trip rate in trips per dwelling unit and the capture rate (i.e. the percentage of trips that use transit). The cost recovery ratio is the average hourly cost of operation times a farebox recovery rate and divided by the average fare per passenger. As such it represents the number of trips per hour needed to generate enough revenue to operate a subsidized transit service. The cost of recovery ratio is the result of government policy as it relates to

¹¹Seattle, *Encouraging Public Transportation Through Effective Land Use Actions*, p. 30, as developed from Pushkarev and Zupan, *Public Transit and Land Use*, p. 140.

SYSTEMS PLANNING/LAND USE

subsidy levels and fares. For example, if a policy is set to have the users pay a major portion of the costs with a high farebox recovery rate, this will require a high transit trip density. If transit fares are raised, then the required trip density would be lower.

The service ratio is the product of the frequency of transit service on the route (vehicles per hour) and the daily hours of operation divided by the average speed of the transit service, including stops. The units of the service ratio are daily vehicle hours of service per route mile. It represents how often transit service is provided. If vehicles operate frequently or for long periods of time during the day it will result in a high service ratio and the need for a higher transit trip density. The final term in the equation, the constant 160, is a conversion of square miles to acres. It is 640 divided by 4 (divided by two because there is two way service and divided by two again because the service area is 1/2 mile wide).

An example can help to understand these tradeoffs. Suppose transit service is to be provided 16 hours per day at 30 minute headways (2 vehicles/hour) and it can be operated at an average speed of 20 mph including stops. The average cost of operation is \$50 per hour with an average fare of \$.75 and a farebox recovery rate of 60%. What is the required trip density?

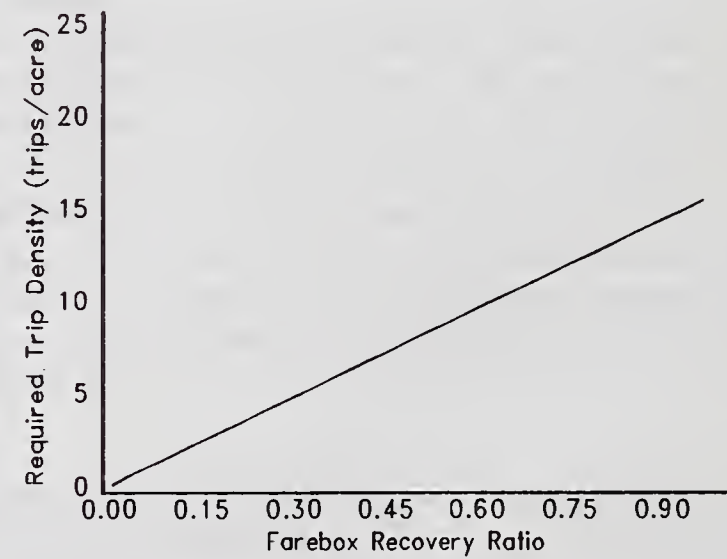
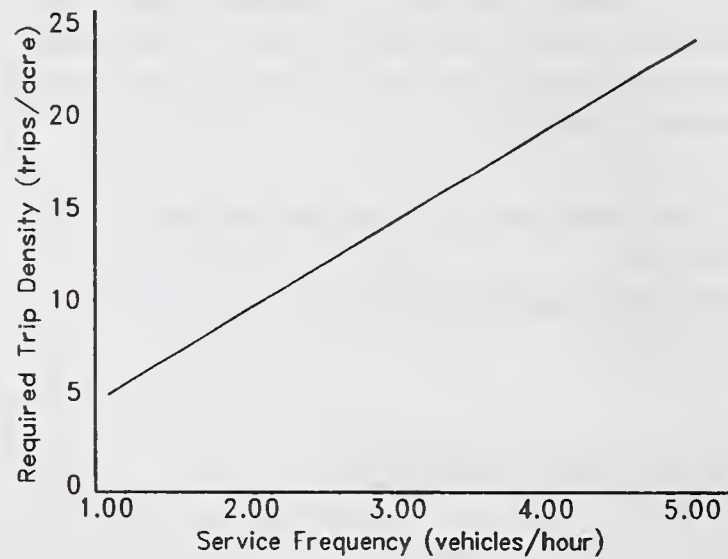
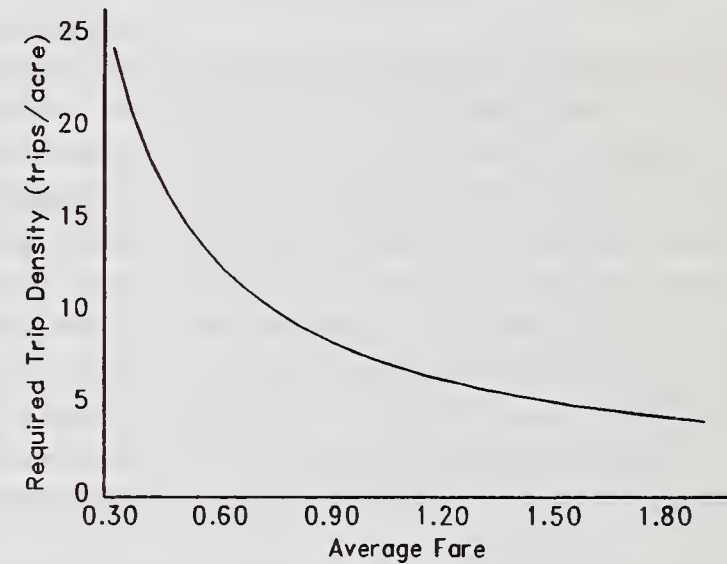
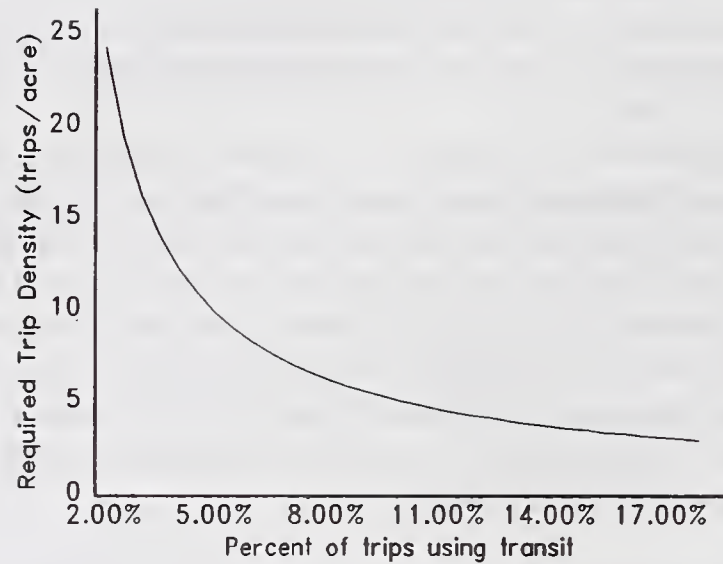
From these data the cost recovery ratio can be found as follows:

$$\text{CRR} = \$50 * .60 / .75 = 40 \text{ passengers/hour}$$

The service ratio:

$$\text{SR} = 16 * 2 / 20 = 1.6 \text{ vehicle hours/mile}$$

SYSTEMS PLANNING/LAND USE



SYSTEMS PLANNING/LAND USE

The required average transit trip density in a route's service area:

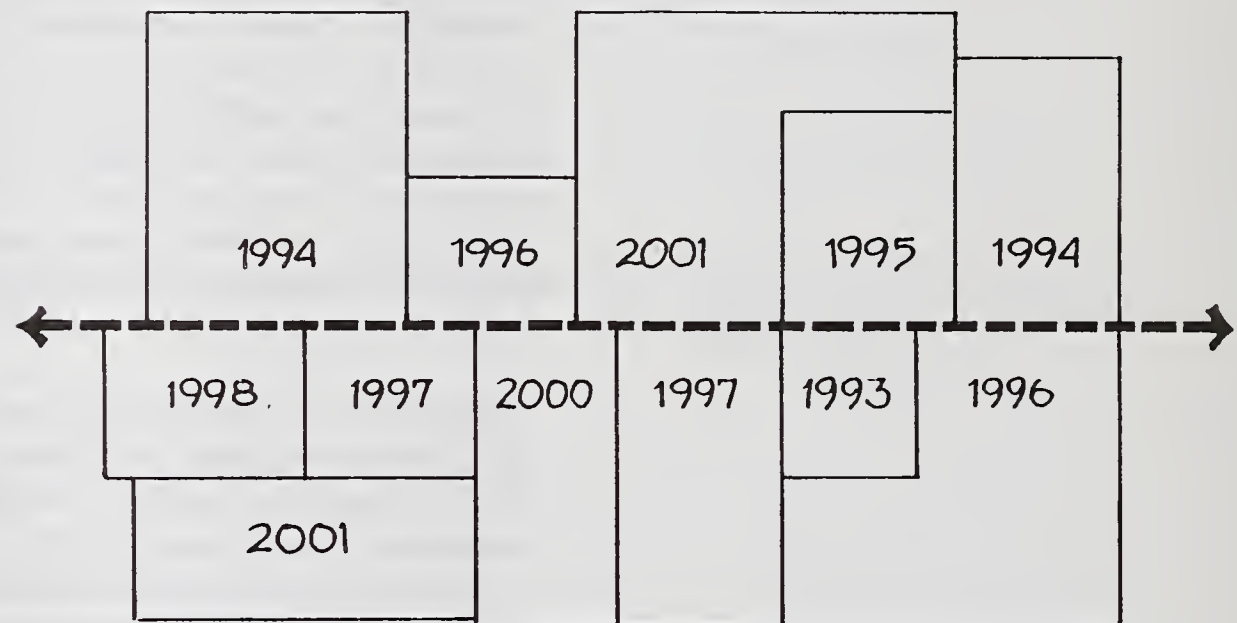
$$TTD = CRR * SR / 160 = 40 * 1.6 / 160 = 0.4 \text{ trips/acre}$$

The required transit trip density can be converted to residential or employment densities given assumptions on the portion of trips that use transit and trip rates per household. There is an important tradeoff between these factors. In the above example, a trip density of 20 trips per acre is required if there is a 2% capture rate by transit, but only 4 trips per acre if the capture rate is 10%. The density requirements drop off rapidly if transit successfully captures market share. On the other hand, a high capture rate is likely the result if there are low fares and high levels of service. These in turn increase the need for higher trip density. Thus there are many combinations of factors that need to be considered in determination of required density levels for transit.

The figures to the left indicate how four of these factors, transit capture rate, average fare, service frequency and farebox recovery rate, affect the necessary trip density. The required trip density varies inversely with capture rate and average fare. An increase in these factors leads to a lower density needed to support transit service. Trip density varies directly with service frequency and farebox recovery rates. If high levels of service are provided, there will be a need for higher densities. These graphs were developed using the data from the example and holding everything constant except the variable on the x axis of the graph. A five percent transit use was used in the base case as well. These indicate that the required residential and employment densities for transit are strongly dependant upon policy (i.e. subsidy rate fares), as well as operational factors.

SYSTEMS PLANNING/LAND USE

Development is Phased Over Several Years' Time



SYSTEMS PLANNING/LAND USE

Design for a phased implementation of transit corridors.

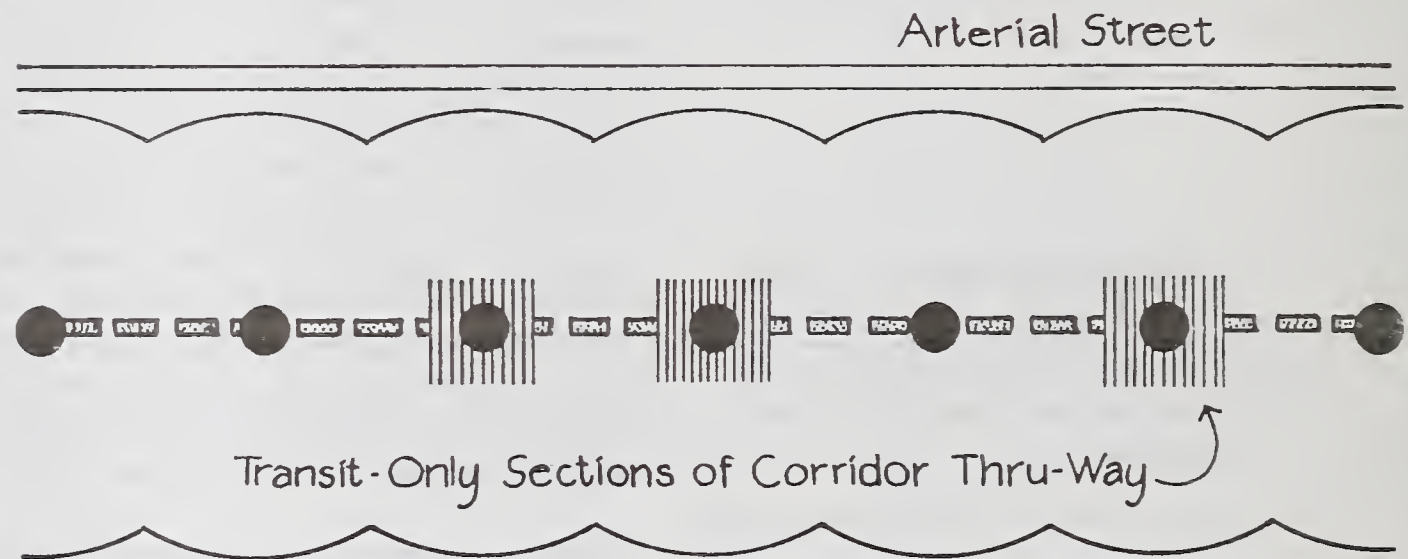
The development of a redesigned suburban environment based on high accessibility to transit services is a long term project. There must be an assurance of quality transit service in order for private developers to commit to projects that rely on transit for a portion of their access. Similarly, there must be a concentration of demand and trip density in order to provide quality transit. Failure to do one leads to the failure of the other. Implementation should be done in phases in order to accommodate intermediate stages of land use and transit services. It is important that the system works well at all points in time so that a viable transit service can be provided to encourage further land use activity. Flexibility is also required since the sequence of projects is largely determined by private developers and market forces beyond the control of local government agencies. The design and associated zoning regulations and approved procedures should provide a framework for implementation which permits flexibility rather than a detailed blueprint. Predesignating transit corridors is an important step in this process. Also there should be a series of intermediate plans which examine viability at earlier stages.

"It is important that the system works well at all points in time so that a viable transit service can be provided to encourage further land use activity."

The transit corridor is not meant to be an automobile-free zone; rather it should be a place where transit dominates and the automobile is accommodated rather than the reverse, which is typical in existing suburban areas.

SYSTEMS PLANNING/ACCESS SYSTEMS

Periodic breaks are made in the transit path to prevent through auto traffic.



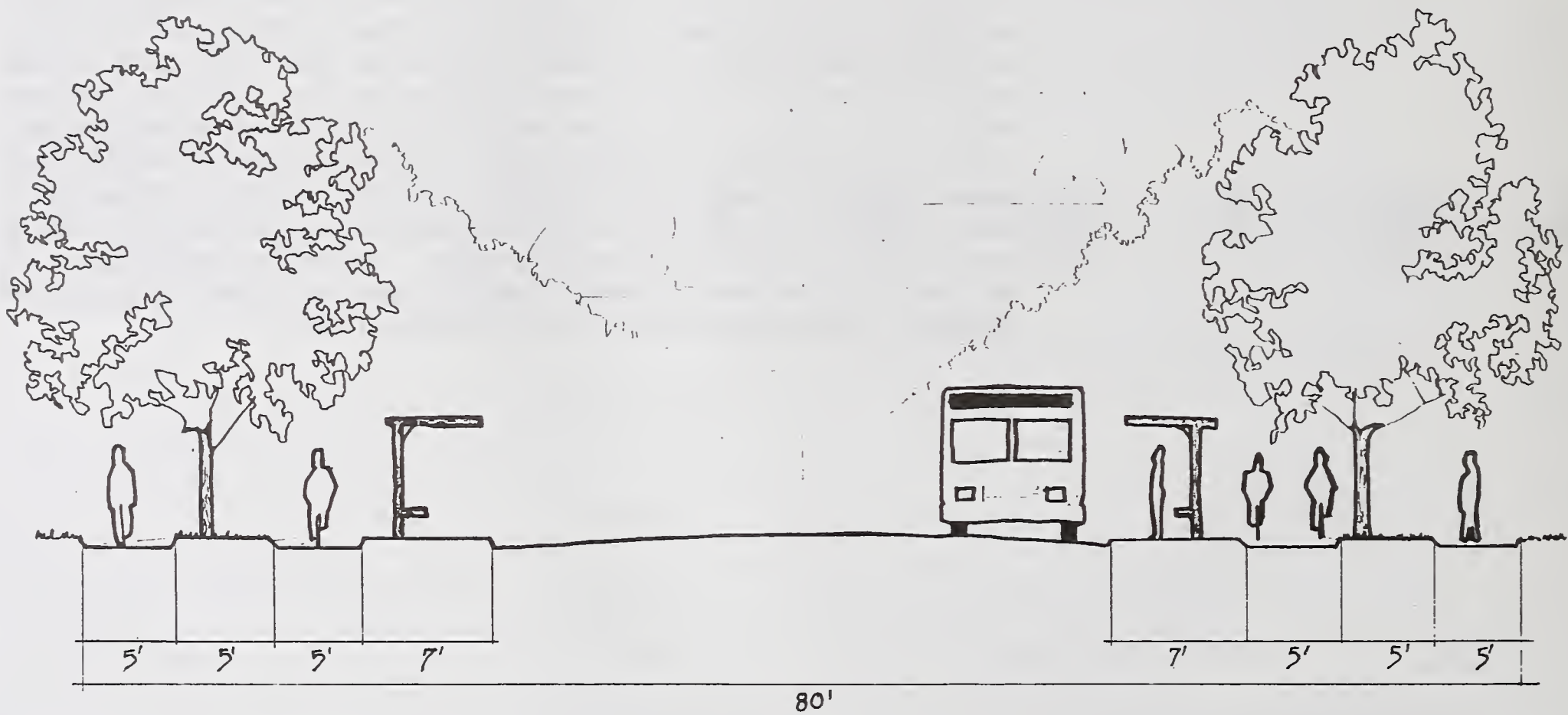
" . . . it is important to control through automobile traffic to prevent excessive congestion along transit corridors."

Control of through automobile traffic.

The provision of a convenient transit service requires a speed and level of service competitive with automobile travel. If transit vehicles operate along a congested street, travel times by transit would be increased and the street would be dominated by auto traffic. TCDs are areas of concentrated development which will generate significant numbers of trips and it is important to control through automobile traffic to prevent excessive congestion along transit corridors. This could be done by providing periodic sections in the transit right-of-way where only transit vehicles would be permitted. This would prevent other vehicles from using the transit path for through movement. These breaks should occur approximately at every mile and would likely be located at high activity stops. The remainder of the corridor could operate with mixed traffic with the roadway serving as a local or collector street. Auto access to the properties in the corridor would be from parallel or intersecting arterials rather than from the transit corridor. Only limited parking would be permitted along the transit roadway. Careful planning will insure a proper mix of circulation without excessive traffic on the transit corridor.

SYSTEMS PLANNING/ACCESS SYSTEMS

Cross-section of Transit Corridor in an 80' ROW

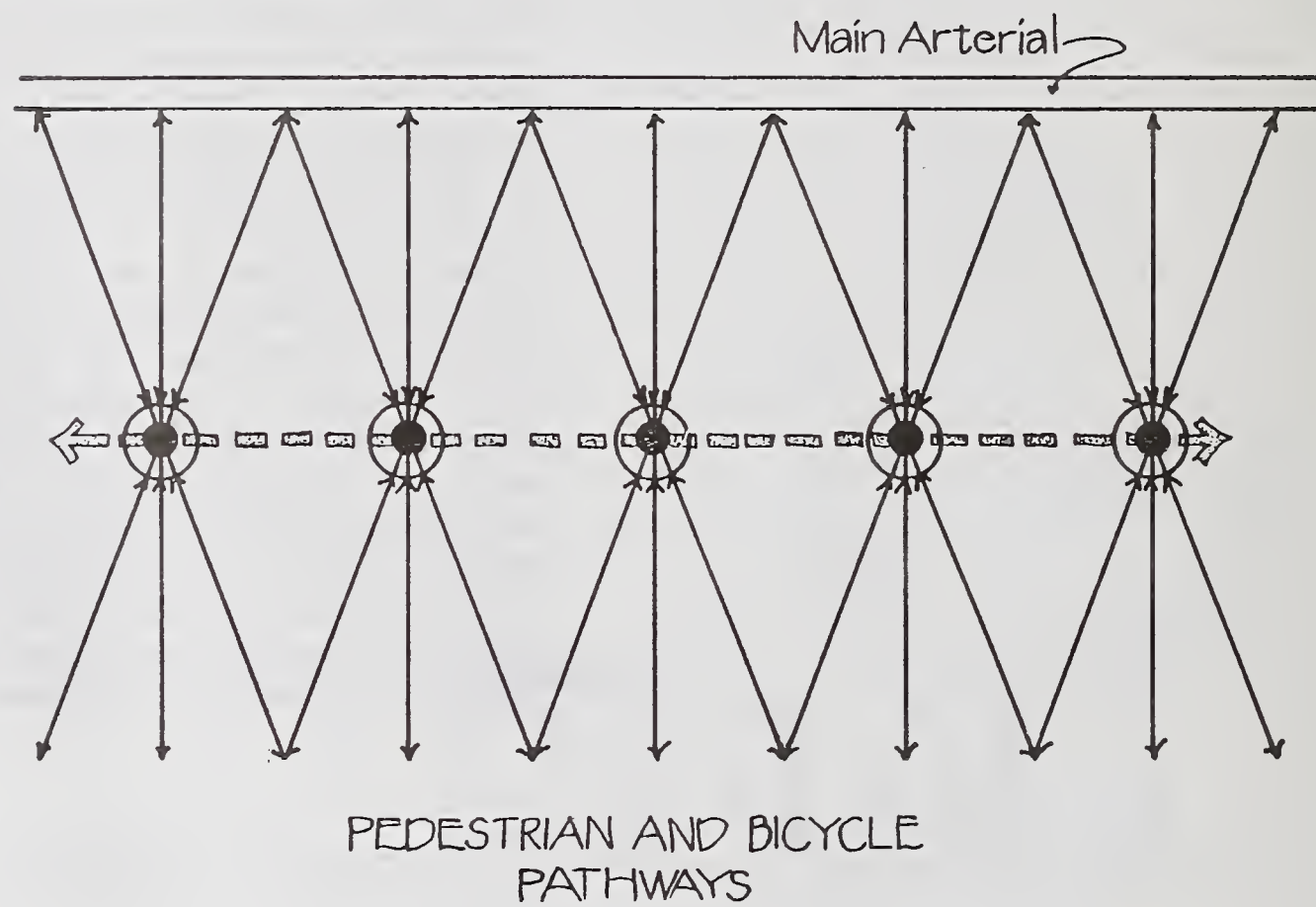


SYSTEMS PLANNING/ACCESS SYSTEMS

Use corridor for primary pedestrian, bicycle and transit movement.

The corridor should be designed to accommodate pedestrian and bicycle movement as well as transit vehicles. Separate pathways should be provided parallel to the transit routes. These pathways should be on both sides of the roadway and accommodate two-way movement. A typical section of the minimum configuration for the corridor is shown in the figure. The corridor should consist of a roadway with a minimum width of 34 feet and shoulder/tree lawn and adjacent pathway areas of a minimum of 23 feet on each side for an overall minimum width of 80 feet. The pathways area would consist of a seven foot wide bike path, a five foot walkway and eleven feet for tree lawn and landscaping. The bike path would be specified as a class I bike path and be wide enough to permit two way movement (AASHTO).¹² There should be a minimum of five feet from the transit roadway to pedestrian path and five feet between pedestrian and bicycle paths. The 34 foot roadway provides the minimum width necessary for transit vehicle stop areas and a bypass lane for through vehicles. A wider right-of-way of 100 to 200 feet is preferred which would provide area for a median along the roadway, and additional roadway areas and green space between the pedestrian and bicycle paths as well as a better buffer between transit service and adjacent uses.

¹²American Association of State Highway and Transportation Officials, "Guide for the Development of New Bicycle Facilities."

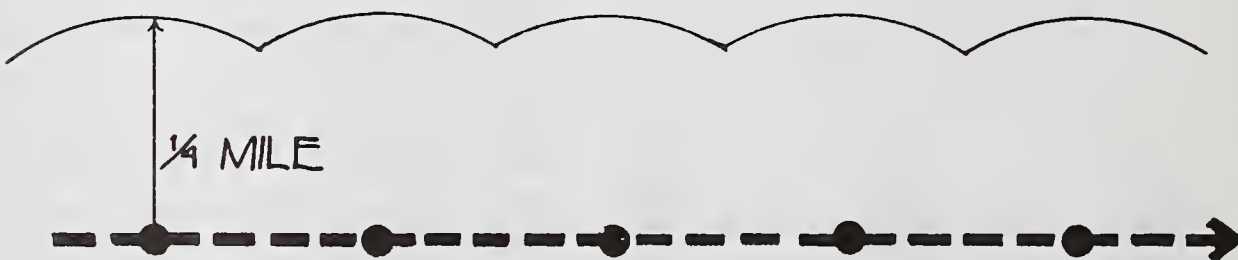


Avoid need for shuttle services.

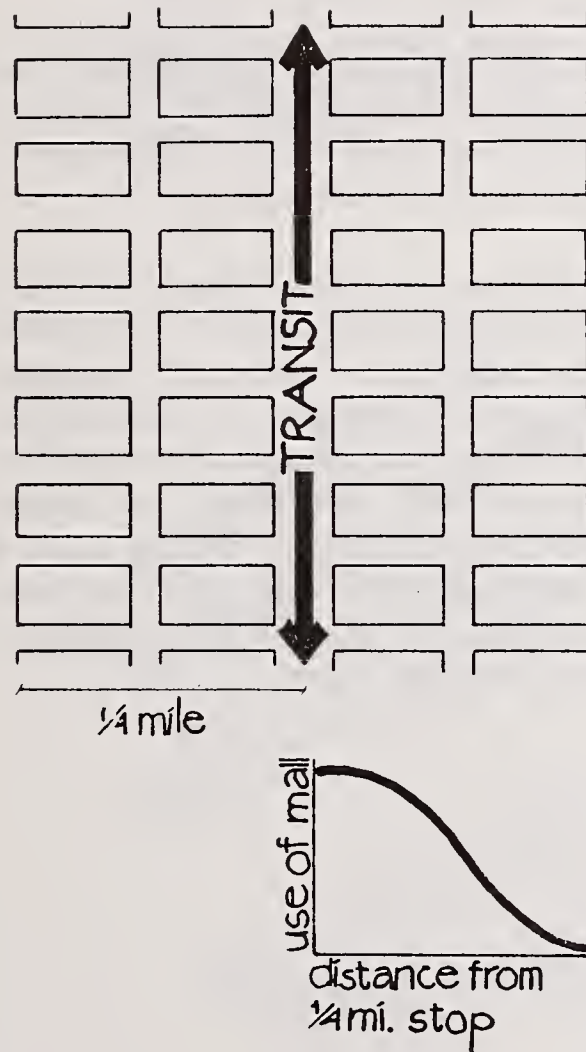
One option that is considered in the design of major development projects is the provision of a shuttle service which connects the project to a primary transit route. This type of service should be avoided. Shuttle services require additional time for users to wait for the shuttle vehicle and to transfer between vehicles. This is highly inconvenient for users in that it involves out-of-vehicle time and transfer penalties. Travel demand studies have demonstrated that out-of-vehicle time to be perceived at two to five times as important as time spent in the vehicle in travel choice decisions. Hence a shuttle service could significantly reduce the potential demand for transit use. A second reason to avoid shuttle services are their costs. To be effective shuttle buses should operate throughout the day and evenings and at low headways. Annual operating costs can run several hundred thousand dollars per vehicle. The result is that service may be cut back to reduce costs. A reduced level of service makes it less attractive to users which in turn will reduce demand.

The ideal situation is to provide direct transit service to and through the center of a concentrated development which connects directly to other activity centers. Developments should be designed to allow transit services to move easily through and to avoid excessive turns or indirect routing.

ARTERIAL



AUTO-ORIENTED LAND USES ARE KEPT NEAR
ARTERIAL TO MAINTAIN PEDESTRIAN MOVEMENT
AT THE TRANSIT CORRIDOR.



Highway/transit relationship.

Corridors for transit service should be a minimum of $\frac{1}{4}$ mile away from, but parallel to, major highway arterials. A parallel highway arterial serves two important functions. (1) Mobility: transit cannot provide service for all people to all destinations, especially traffic passing through the area; automobiles will be required for some travel. (2) Land access: while the transit line will be able to serve most development, there are certain land uses that are incompatible with transit and which need auto access. There are also developments, like major shopping centers, that are best served by both transit and auto access.

A minimum distance of one quarter mile should be maintained between the arterial highway and the transit line. A large proportion of the public will utilize transit if located within a quarter mile walking distance of their residence or work place. Access to the highway arterial is also convenient at this distance for those uses that need access to both modes of transportation.

SYSTEMS PLANNING/TRANSIT SERVICES

Provide high quality transit service.

Transit service should be of high quality to attract users from the automobile. The concept of a Transit Corridor District provides a concentration of land uses, connected by a high quality pathway system to the transit system. The transit service itself should have high operating standards to assure its continued use.

Transit can be successful in attracting ridership if a user-oriented service is provided. A high quality user-oriented transit service requires that direct service is provided between a user's origin and destination, without the need to transfer, at a schedule which matches the user's needs, at a reasonable cost compared to the automobile, and in a clean, comfortable, reliable, safe and secure vehicle. If transfers or waiting are necessary there should be a safe, secure and interesting place to wait and change vehicles. Information on how to use the system, its routing, when, and how much it costs should be readily available and easily understood. If these conditions are met, people will use transit. More transit use will reinforce the land use plan which can in turn generate a higher level of transit service and more usage.

"Efforts to design a cleaner, quieter, and higher quality vehicles are critical for the development of the overall concept."

Roadblocks To Public Transit

For reasons ranging from prejudice to pragmatism, many suburbanites are fighting tooth and nail to keep mass transit out of their neighborhoods.

By Nicole Aches, Editorial Assistant

On a mild, early March evening last year, Marion Roberts waited for his wife at an Atlanta rapid rail station. At 5 p.m., the station was active as work-weary passengers shuffled to buses and cars, anxious to get home. Here and there came a set for the darker realities of everyday urban life changed, and the brightly lit station became a set for the darker realities of urban violence.

Roberts, waiting in his car, was accosted by a group of teenage boys. The leader brandished a gun and demanded Roberts hand over the keys. When Roberts refused, the teenagers pulled him from the car and shot him repeatedly.

Two of the assailants jumped into the car and sped away, and the others disappeared. Roberts fell to the ground.

For city-dwellers, the violence. But for many problems that may play equal parts in suburban neighborhoods.

As if such imbalances were not enough for transit authorities, the images of "underfunded" and "overcrowded" transit systems have left an image of public transit and its role in the community.

Transit vehicles should be quiet and have low air pollution levels.

Transit vehicles, especially buses, have a very poor image in suburban areas.¹³ Local residents will often protest the location of bus routes in their neighborhoods because of the noise and air pollution produced by the vehicles. Noise levels of buses (in the range of 80-85 dbA while pulling out from a stop) are excessive and would need to be significantly reduced in order to prevent negative reactions to transit services. Similarly, vehicle emissions of pollutants and visible exhaust need to be reduced. Transit service in the corridor district must be of a high quality to both attract patrons and not be a nuisance in the community. Efforts to design a cleaner, quieter, and higher quality vehicles are critical for the development of the overall concept.

¹³ *American City and County Magazine*, January, 1991, p. 28.

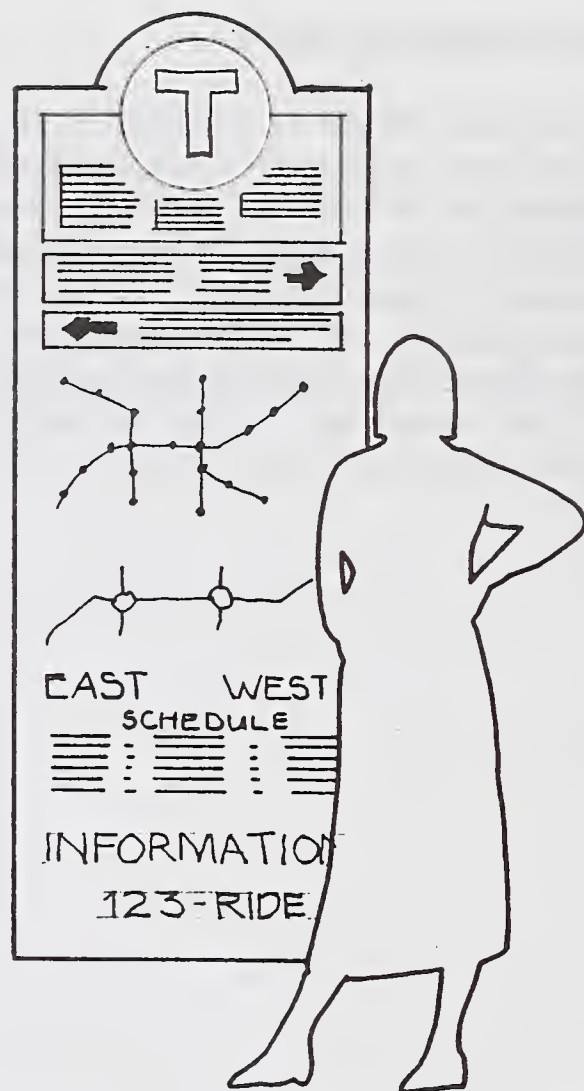
Identity: Signage and compatibility of stops.¹⁴

Transit stops along the corridor are entry points to the transit system. At a minimum these would be equipped with a shelter and associated information and signage. The transit stop is the first image many passengers have of the system as well as being an important piece of "street furniture" at the neighborhood scale. Therefore it is important to make it positive and recognizable.

- Provide colors, logos and forms which produce a sense of identity for the system itself.
- Use materials and images that are compatible with the surrounding community.
- Locate shelters so they can be seen and identified from a distance.

Signs identifying the stop and route should be designed to provide clear understanding for all users including those unfamiliar with the English language in appropriate neighborhoods.

- Maintain consistency throughout the system -- logos, color, lettering.
- Place information in direct lines of sight.
- Construct signage of low-maintenance materials.



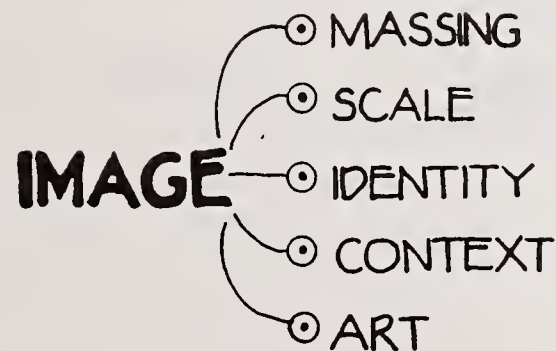
¹⁴Rabinowitz, *et al.*, "Market-Based . . .," pp. 202, 203.

SYSTEMS PLANNING/TRANSIT SERVICES

The local stop is located along a transit corridor which may also serve as a collector street. The stop is surrounded by residences and occasionally a small shopping area.

The transit stop must fit into and enhance the neighborhood.

- The shelter must be compatible with the area that the station serves. Consider elements such as roof slopes, height, materials and details.
- Provide an image that is understandable and acceptable to the local community.
- Landscaping is an important design feature at the local community level.
- The facility should be identifiable as part of the transit system overall design.
- Climatic conditions should be considered, orient the stop if possible to take best advantage of sun exposure and wind conditions.



DISTRICT PLANNING

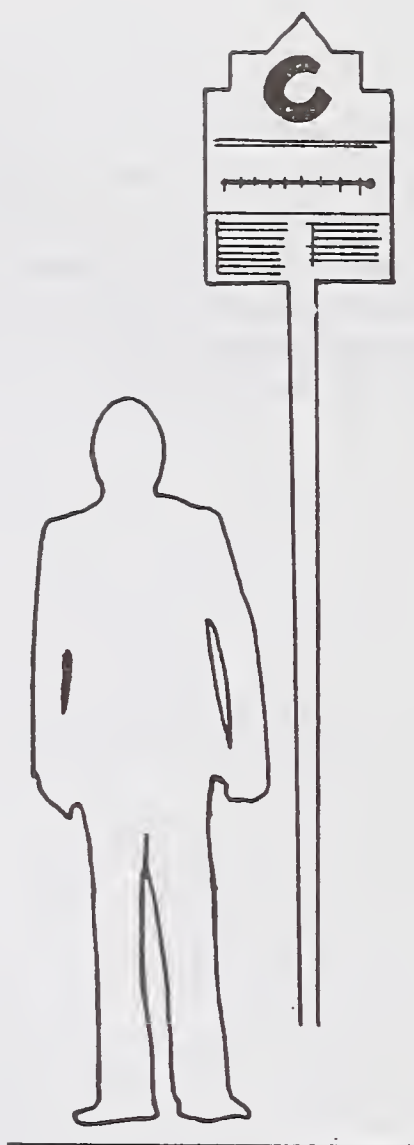
DISTRICT PLANNING

H. District Level Guidelines

	System Planning	District Planning
Policy		
Land Use		✓
Access		✓
Transit		✓

Guidelines for design and planning within a Transit Corridor District are provided in this section. These include guidelines related to land use, access systems and transit services. Land use guidelines include consideration of the mix and arrangements of activities, phasing of development and flexibility in implementation. Access guidelines provide specific details for pedestrian and bicycle pathways and the provision of feeder services. Finally, transit service guidelines relate to details of service design, transit stop features, safety, security and maintenance.

DISTRICT LEVEL/LAND USE DESIGN



Designate type and location of transit stops.

The designation and location of transit stops is a key decision in the planning process for a Transit Corridor District. This should be one of the first decisions to be made so that land use patterns and access systems can be designed to maximize potential transit use. Pedestrian use of transit falls off rapidly when offices or residences are located more than 1/4 mile from a stop. In order to provide quality pedestrian access, stops should be spaced no more than 1/4 mile apart, which provides a maximum walking distance of 1/8 mile for trips beginning or ending on the corridor itself and a band width 1/2 mile wide for concentrated land use related to transit. The overall pattern is a series of overlapping concentric circles that define the zone of transit-oriented land uses. These areas (stadtwurst -- sausage city) may be separated by areas of open space where stops are omitted. In areas of concentrated demand stops could be located closer together, as close as 1/8 mile to improve accessibility.

Transit stops should be placed away from auto oriented arterials and closer to trip generators. A general pattern where arterials are located at one mile spacings would be to locate the stops at 1/8, 3/8, 5/8 and 7/8ths of a mile from the first arterial. This would provide four locations for more intense land use with the outer two served by both transit and auto and the inner two more transit oriented. Where arterials are at a 1/2 mile spacing, stops would be at the 1/8 and 3/8ths points -- the segment between these two stops (or between the interior stops with 1 mile arterials spacing) would likely be a logical location for a transit-only segment on the corridor.

A local residential stop may serve 200 riders each day and contain a newspaper/candy kiosk open at peak hours only.

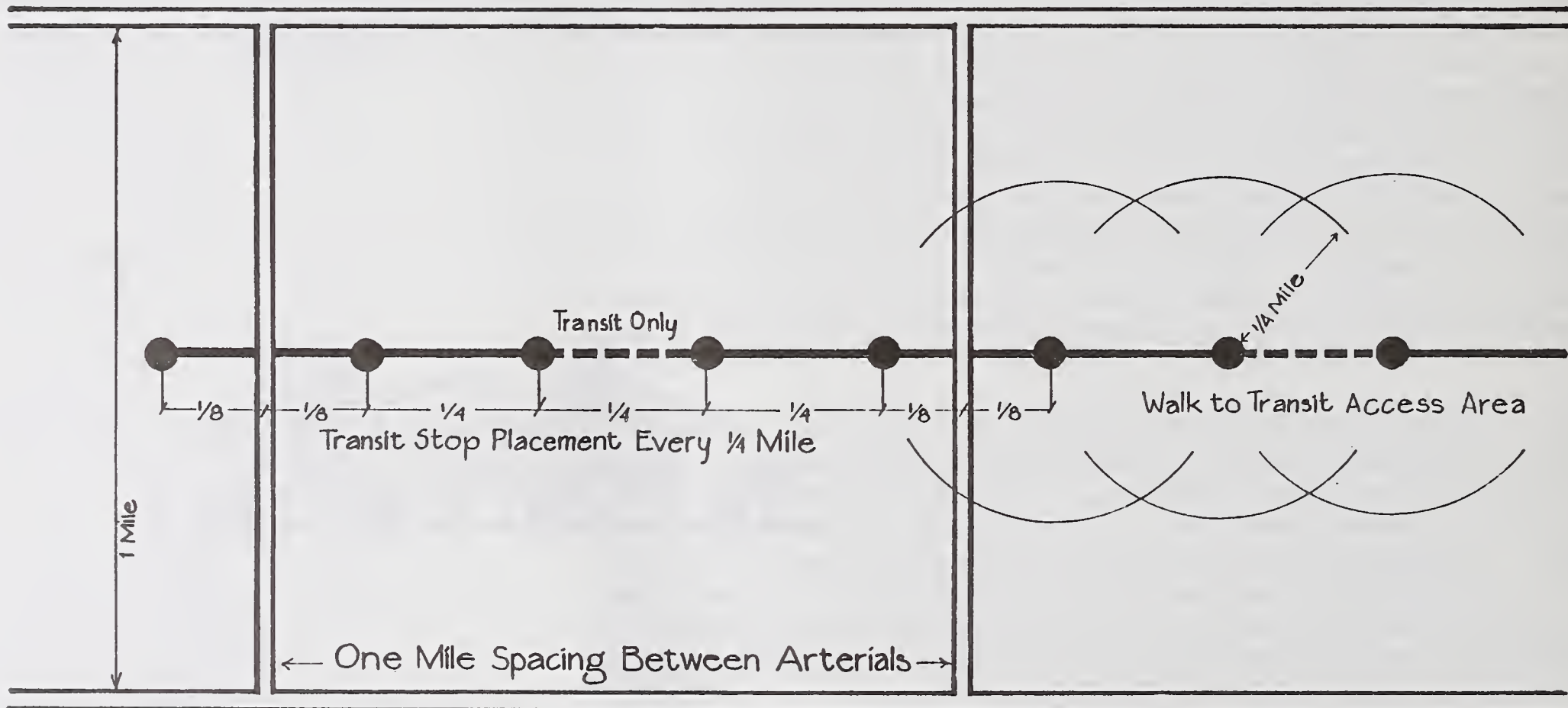
DISTRICT LEVEL/LAND USE DESIGN

- A local residential/local office/shopping stop may generate 600 riders per day.
- A office/retail center may generate 6,000 passengers/day and have a full complement of specialty, retail, and convenience stores as well as places to eat.



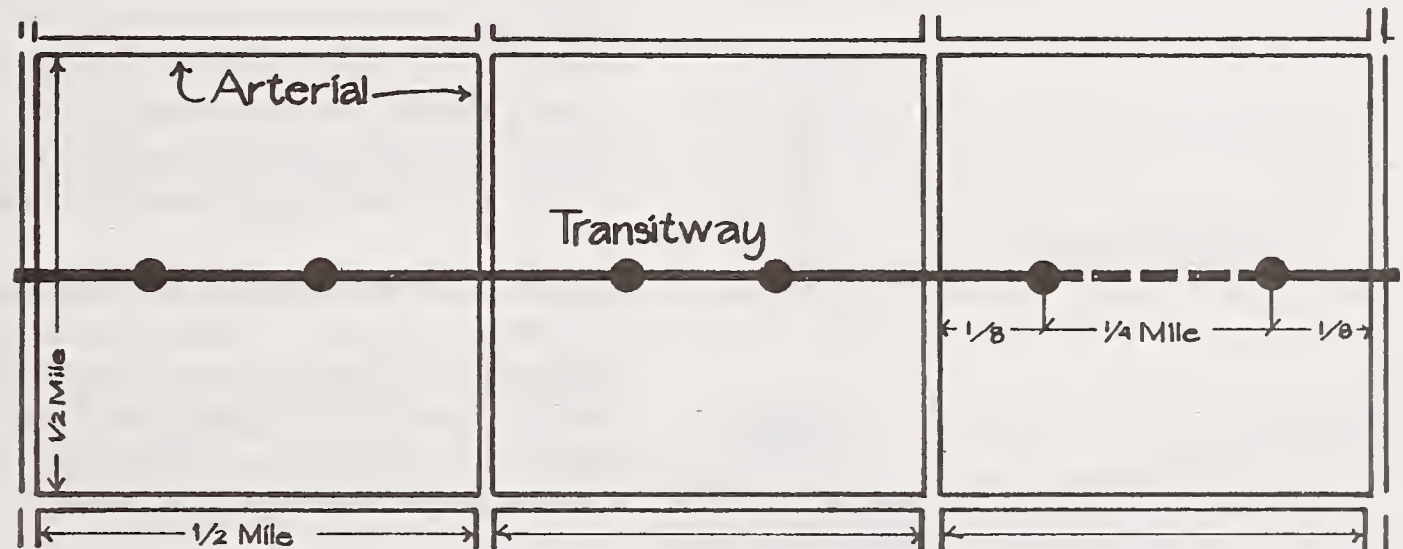
DISTRICT LEVEL/LAND USE DESIGN

Figure showing one mile spacing between arterials



DISTRICT LEVEL/LAND USE DESIGN

Figure showing one-half mile spacing between arterials



DISTRICT LEVEL/LAND USE DESIGN

Provide mixed land uses, including housing, office, retail, industrial, and recreational uses.

Traditional suburban zoning can be characterized by a separation of land uses such as residential, commercial, educational and recreational land uses, requiring the use of the car and many separate trips. By locating different land uses in close proximity to each other, two benefits can be achieved. First, the total number and length of trips by people within the area can be reduced. It will not be necessary to travel to numerous locations when running errands because most destinations would be within a few minutes walking distance of each other.

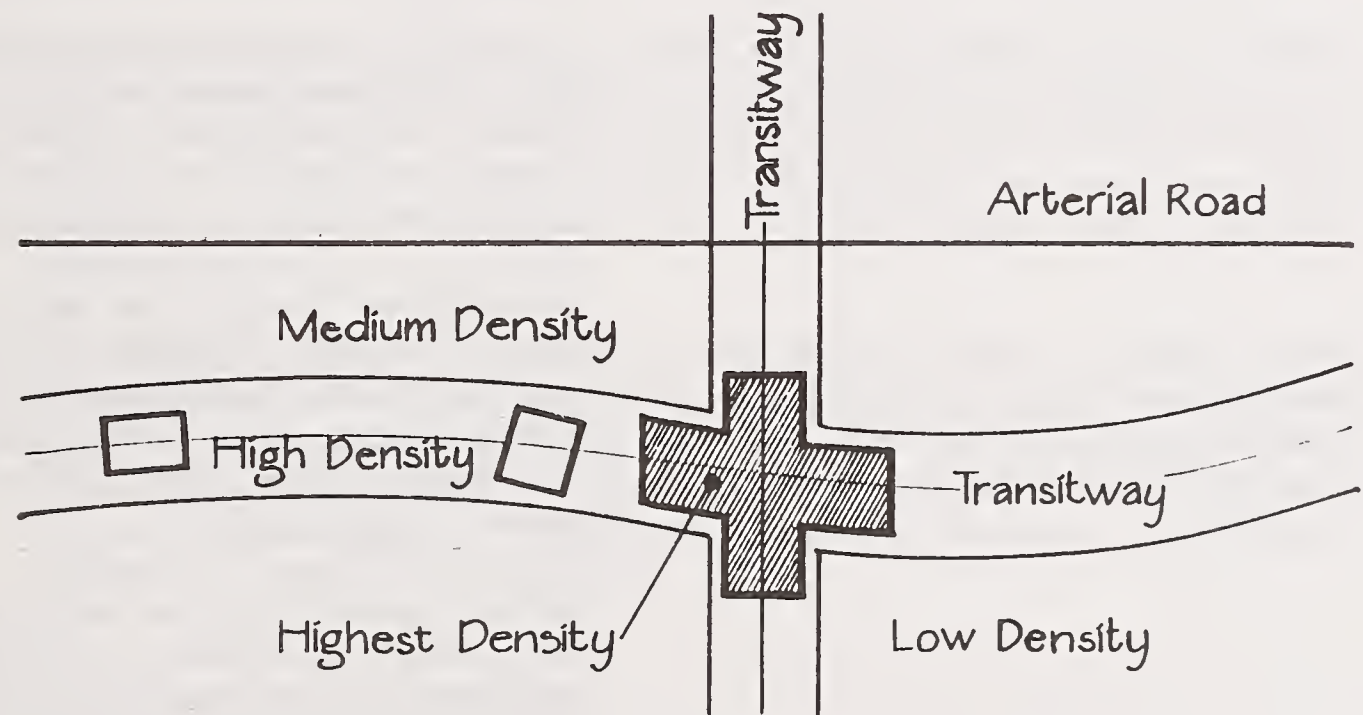
The second advantage of mixed use activities and land use is the improved feasibility of transit service. Transit operates best when there are simple origins and destinations. A major reason suburban residents do not use transit is because of the need to make trips to multiple locations during the day. If these activities and destinations can be consolidated and located along a corridor, the auto's advantage over transit will be greatly reduced.¹⁵

Land uses should be arranged to maximize the potential for walking and bicycle trips as well as by transit. A mixture of activities including housing, employment, shopping, public facilities and schools is desirable around each transit stop. Densities would be highest near the stop and then remain fairly high within the 1/4 mile walking distance of transit. Beyond this area densities would be lower and there would be little effort to serve these areas with pedestrian access to transit. Land uses

¹⁵Calthorpe, *Transit Oriented Development Design Guidelines*, p. 23; Snohomish County, p. 5-2.

DISTRICT LEVEL/LAND USE DESIGN

less compatible with transit (lumberyards, auto dealerships, etc.) should be located further from transit¹⁶.



¹⁶Delcan Corp., p. A-22.

DISTRICT LEVEL/LAND USE DESIGN

Relate design to the market.

For a development to be successful it must attract tenants and purchasers who are drawn by the features, character and cost of the project. In the United States private sector real estate developers construct over 90% of new building; this project must be able to compete against other private sector developments.

The public's attitudes towards housing choices are changing. The provision of a life style is now important to the public in addition to a home. The character of the development is also critical. While a functional, for instance, a split-level house was a typical purchase in the past, a distinctive style is now desired. The quality of 'neighborhood' is also an important criterion for many potential homeowners.

The attributes resulting from many of the guidelines contribute to the ambience desired by much of the public. The density and walkability of the district imparts a neighborhood feeling as does the variety of scope of services in proximity to the housing. Recreational and civic services are also provided. The mix of housing types also provides a heterogeneous character and the ability to market to a broader segment of the population.

The area should be given an identity based on the character and location of the site. For example, Greendale, the Cascades, Laguna West, Sandy Springs, all developments documented in the first report of this project, provide an identity and cachet for their projects. Identity should be continued at the neighborhood scale. In the prototype development designed as part of this study, each tract was provided a unique name, such as the 'Woods' and the 'Estates' area. Each tract has a different character, and often there are distinctions even within each tract based on the natural features and topography of the area.

DISTRICT LEVEL/LAND USE DESIGN

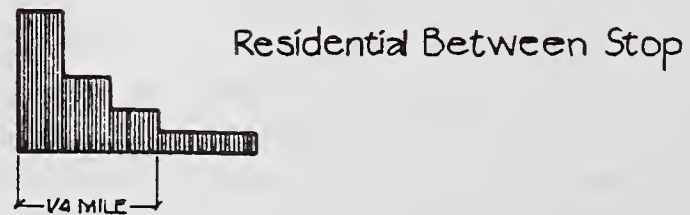
Provide variety within the district.

While a common themes should be created for the entire district, there is a need to avoid too much uniformity in the area. It is important to develop variety within the project in order to create unique places and interest with which residents can identify.

To develop this variety, a number of criteria and design methods can be employed. Each tract within the TCD, for instance, has a required mix of housing units to attract a variety of users. Retail and commercial uses are also present throughout the district. Small parks can be required in each tract and these can provide a focus and unique attributes to areas within a tract. Natural features of each area within a district should also be respected.

In addition, a variety of developers, planners and designers should be used throughout the district. Using the guidelines presented in this report, they will create very different schemes. The firm of Duany-Plater-Zyberk uses this method for many of their larger projects. The prototype that we have proposed in the final section of this report was designed by five faculty and students from the Department of Architecture, based on the guidelines.

DENSITY GRADIENTS



DISTRICT LEVEL/LAND USE DESIGN

Land use density gradient.

Existing suburban development patterns result in low density developments which cannot support transit operations and mixed use development. Increased densities and a variety of building types are a necessity for the feasibility of a Transit Corridor District. Density levels near traffic arterials would be similar to existing suburban densities -- for instance, a floor area ratio (F.A.R.) of .3 for commercial uses and .1 for housing. However, commercial uses and housing in proximity to transit stops may have minimum FARs in the range of 1 to 3. Different parts of the district, depending on the concentration of activities, will vary in their FAR profile.

DISTRICT LEVEL/LAND USE DESIGN

Utilize appropriate land use adjacencies.

A prime consideration for planning development on proximate parcels should be the compatibility of land uses. Thoughtful location of land uses can create the same benefits as mixed-use developments. Neighboring projects should be compatible in the sense that there will be a high pedestrian movements between the sites. This can reduce the need for auto trips.

DISTRICT LEVEL/LAND USE DESIGN

Provide recreational opportunities and amenities.

A Transit Corridor District should be an attractive place to live with high quality amenities and recreational opportunities. The pathway system which links transit to buildings should be located to take advantage of natural features and to be usable for neighborhood circulation and exercise. Amenities should be distributed throughout the corridor but with a gradient away from the transit route. Those nearest the transit route should be relatively small and would be places where people can gather and interact. Those amenities located furthest from the route would be larger, open spaces for outdoor sports and/or natural areas.

A TCD should provide a range of civic and private amenities at all levels of the project. District-wide amenities could include an outdoor recreation facility, perhaps tied to a school, a library, ice skating rink, farmers' market area, a civic plaza, athletic fields, playgrounds, tennis courts, youth centers and parks.

The quality of the landscape is an important symbol and visual feature of the suburbs. The projects reviewed in the first report of this project all contained a strong landscape element. Landscaping at all scales, from the transitway, to the scale of the block and small park, is a critical part of the success of this development.

Private sector amenities are also required. Opportunities for socialization such as coffee shops, restaurants and bars should be a part of the planning as well as retail opportunities for teens and children. Events are significant to create a spirit of neighborhood and district, and parades, festivals, arts and crafts shows, and so on should be planned. The position of recreation/social coordinator should be created to implement events and activities for the residents.

DISTRICT LEVEL/LAND USE DESIGN

Accommodate multiple developers and development patterns.

The integration of a variety of developments and land use patterns is critical to effective completion of a transit corridor. Developers often specialize by building type, therefore regulations must accommodate various building uses; changing market forces also require local development regulations to be flexible. Although the underlying highway arterials and transit line must be firmly established; road patterns within the district can vary.

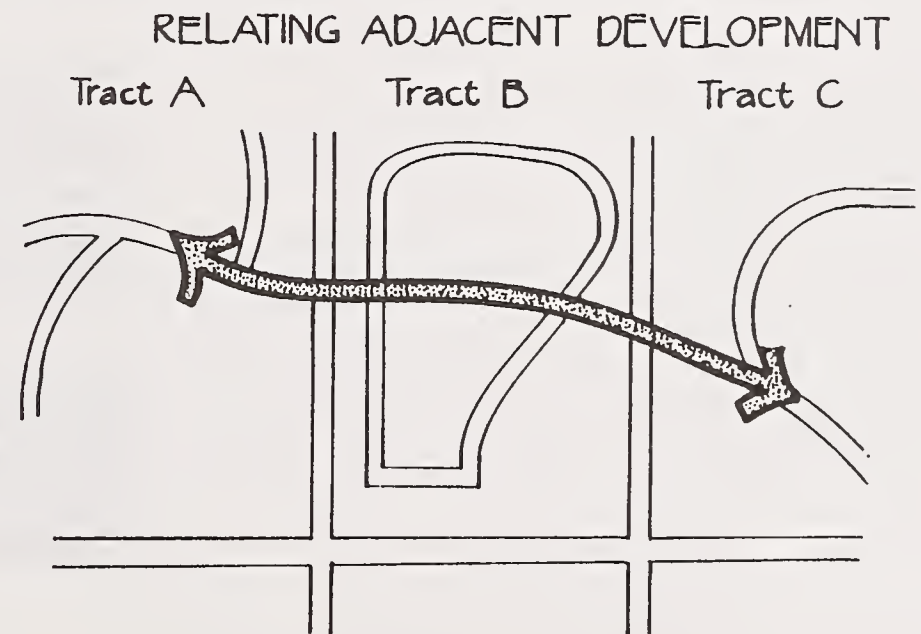
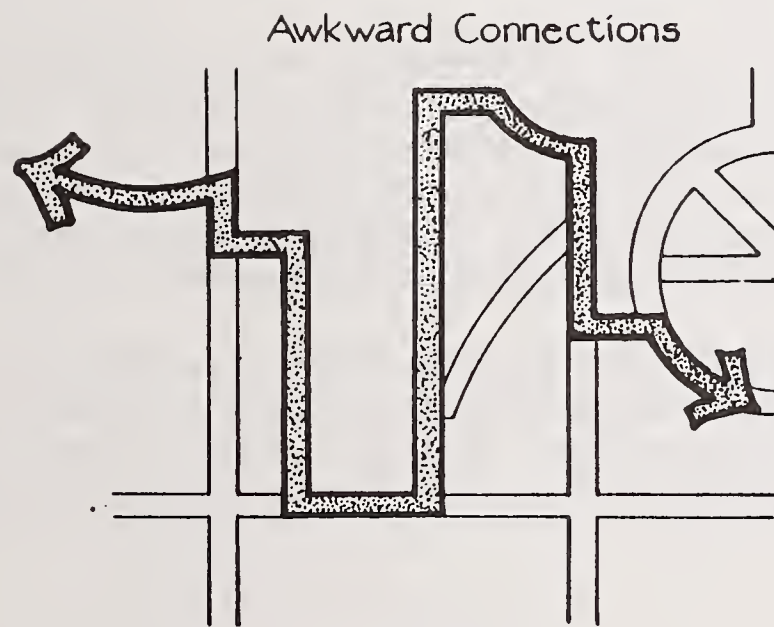
The use of guidelines for density, land use, and parking gradients provides a basis of regulation for development patterns while at the same time allowing flexible development. Developers use the desired land use characteristics of each sub-area of the TCD, though each developer should be allowed to reach the final objectives in different ways. This provides the diversity and real estate feasibility that is necessary for the long term survival of a transit-sensitive community.

The final part of this report contains a prototype design in which each major section was planned separately. However, each designer used these guidelines as criteria. The result is a diversity of character and experiences for each tract notwithstanding adherence to a common set of criteria.

DISTRICT LEVEL/LAND USE DESIGN

Relate the design and connections of adjacent developments across 'seams'.

The incremental planning and development of suburban subdivisions and parcels results in an unrelated functional and visual environment between these tracts.¹⁷ These mismatched 'seams' can be avoided in a master planned district. Each land development parcel should be required to include access points to neighboring tracts in their site planning. The coordination of these seams and connections should be strictly regulated by the district. The visual character of these adjacent parcels, which also serve as major entries to the district, should also be coordinated by the design of landscaping, building setbacks and massing, the placement of landmarks, etc.



¹⁷Snohomish County, "Guide . . .," p. 7-4.

DISTRICT LEVEL/LAND USE DESIGN

Parking density gradient.

The need for great amounts of parking for many suburban functions results in sites and designs that are dominated by parking lots. While access by automobiles and parking will still be required for many uses, the need for parking near uses served by transit will be limited. A Parking Density Gradient, based on building use and the anticipated mix of transit/automobile use will be used to develop the amount of parking within a district. Those uses near transit stops will have limited parking, while a traditional amount of parking should be provided near the auto arterial. The exception to this would be when auto spaces are dedicated to the transit service such as in the case of park and ride lots.

Zoning regulations in a TCD will address the issue of parking lot size at various distances from the transit service.¹⁸ Development nearest a transit line should necessitate fewer auto parking spaces than are presently required by most suburban zoning codes. In fact, the presence of large parking lots with free parking can discourage use of the transit system. Less parking area will also permit a higher density of development and a better network of pedestrian pathways.

Property near an auto arterial will require the size of parking areas to be similar to present suburban zoning requirements. Development in this area will be of a lower density and more auto dependent. The types of land uses found along a highway would be those rated with a 1 or 2 (low rating) on the transit compatibility chart (Appendix A).

¹⁸Snohomish County, "Guide . . .," p. 5-6.

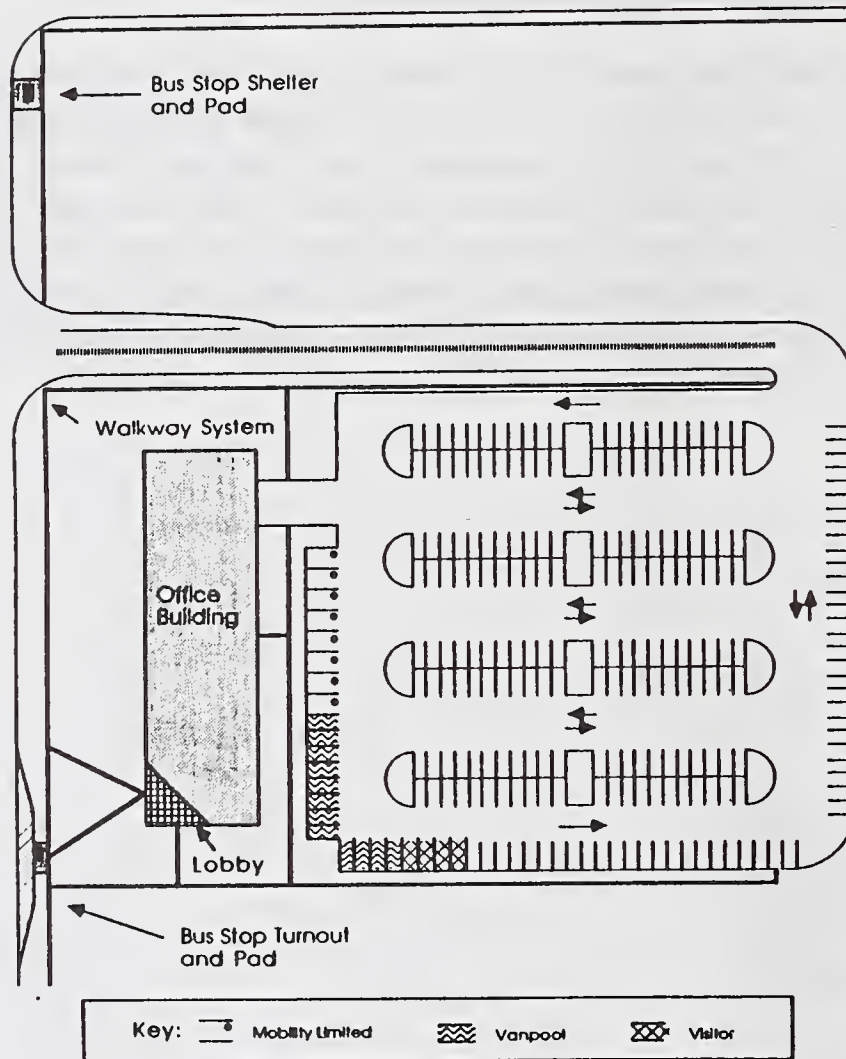
DISTRICT LEVEL/LAND USE DESIGN

Develop a program to encourage shared parking facilities.

Whenever possible, adjacent land uses should be planned to allow the use of a single parking facility for more than one activity. Land uses that require parking facilities during different parts of the day can share a common lot. This will reduce the amount of parking area needed to serve the same land uses. For example, one parking lot could be used as a transit park and ride lot during the day, as theater parking during evenings and for church parking on Sundays. Shared parking facilities reduce the need for surface parking, thus allowing higher density development to take place.

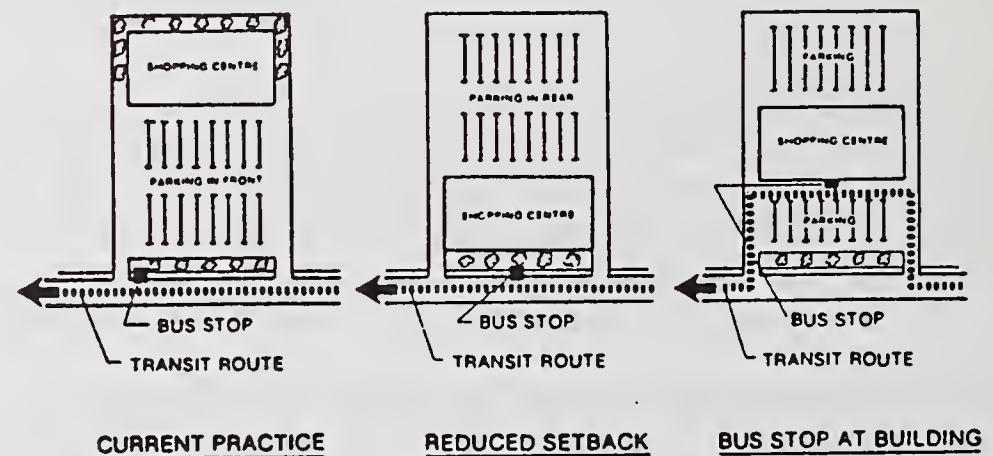
DISTRICT LEVEL/LAND USE DESIGN

TRANSIT SERVICEABLE DEVELOPMENT



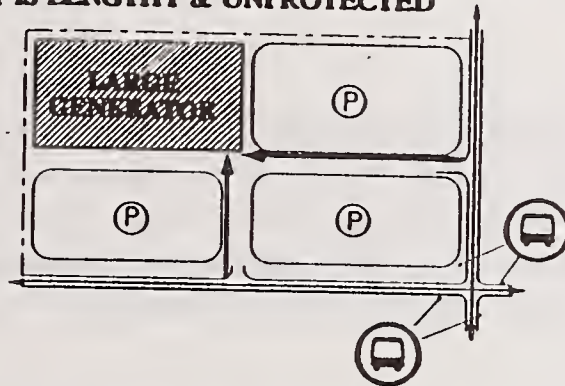
EFFECT OF SITE LOCATION ON TRANSIT PERFORMANCE

from : Levalle Inc., for CMHC, 1979

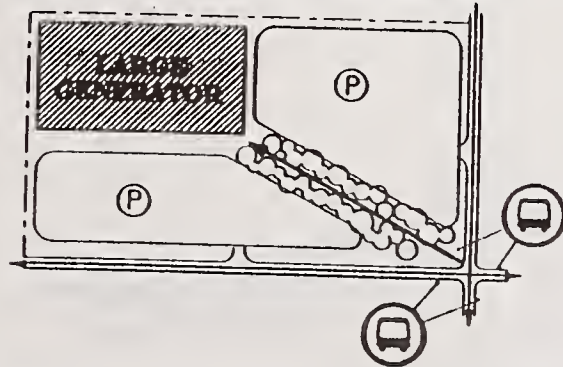


¹⁹Source: PACE Development Guidelines, p. VI-11, British Columbia, "Guidelines . . .," p. 30.

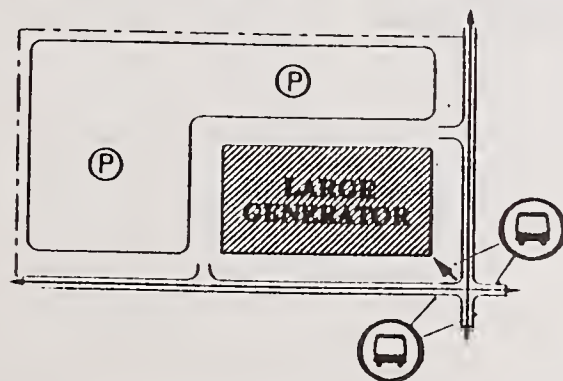
1. POOR
PEDESTRIAN ACCESS THROUGH PARKING LOT IS LENGTHY & UNPROTECTED



2. BETTER
PEDESTRIAN ACCESS ALONG LANDSCAPED MEDIAN IS LENGTHY BUT PROTECTED



3. BEST
PEDESTRIAN ACCESS IS SHORT & PROTECTED



DISTRICT LEVEL/LAND USE DESIGN

Minimize the distance between building entrances and transit stops; provide logical connections between buildings and transit.

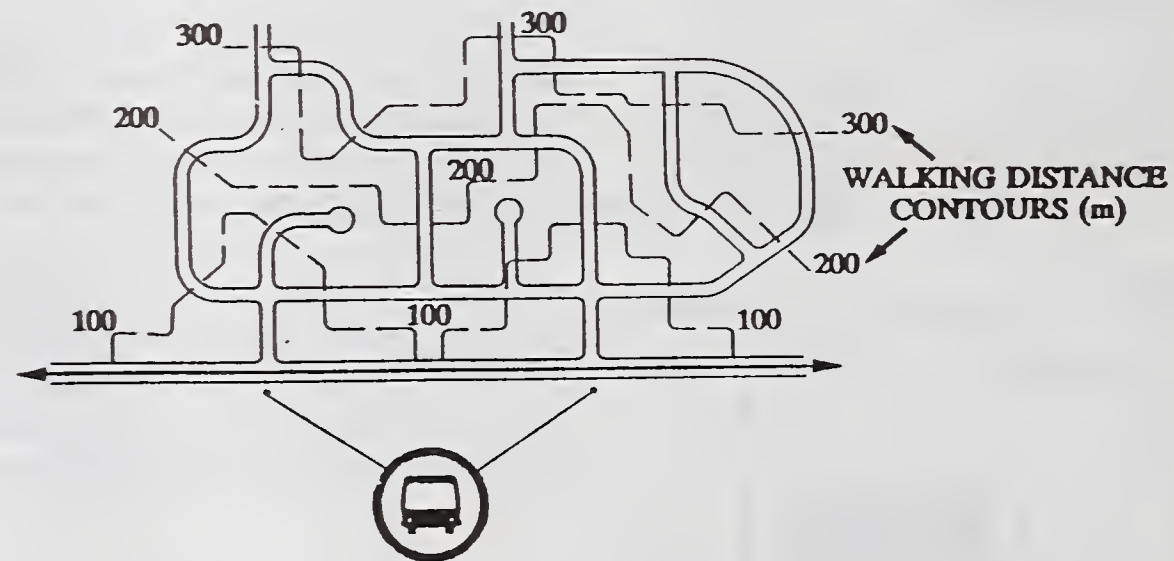
Nearly all trips begin in a building and end in a building. To maximize the potential for transit, building entrances and transit stops should be located in close proximity to each other. Moreover, there should be a clear, direct path between the building and transit stop locations. While this may seem obvious, it is seldom done in conventional suburban development. Transit stops are located on arterials and it is necessary to walk considerable distances through parking lots and across grassy areas to get to a building. Pedestrian walking distances should be measured along the actual paths, not just straight line distances.

There are various ways to provide good access to buildings, especially in the site design phase of development. Ideally, buildings and their entrances can be directly located next to transit stops. This may mean locating parking or open space behind or beside a building rather than in front of it. Buildings themselves could be set perpendicular to the transit corridor rather than parallel to it. This allows for direct transit access to a building as well as access to other buildings. It is also beneficial to cluster buildings together rather than designing in a "strip mall" fashion. This permits shorter and safer travel for pedestrians between buildings.²⁰ Finally, pathways should be provided from all transit stops to surrounding buildings for safe and reasonable access. People cannot be expected to walk across open land without pathways, especially during inclement weather.

²⁰PACE, p. VI-8; Delcan Corp., p. A-6; Snohomish County, p. 5-11, p. 8-5.

DISTRICT LEVEL/LAND USE DESIGN

Municipalities can ensure compliance with these principles by modifying the zoning ordinance. New developments should be required to provide site plans with walking contours shown. The contour lines should be representative of the actual walking distance along pathways to the transit stops. This will help to reveal deficiencies in pedestrian accessibility at a time when they can still be easily changed.²¹



²¹Delcan Corp., p. A-11.

DISTRICT LEVEL/LAND USE DESIGN

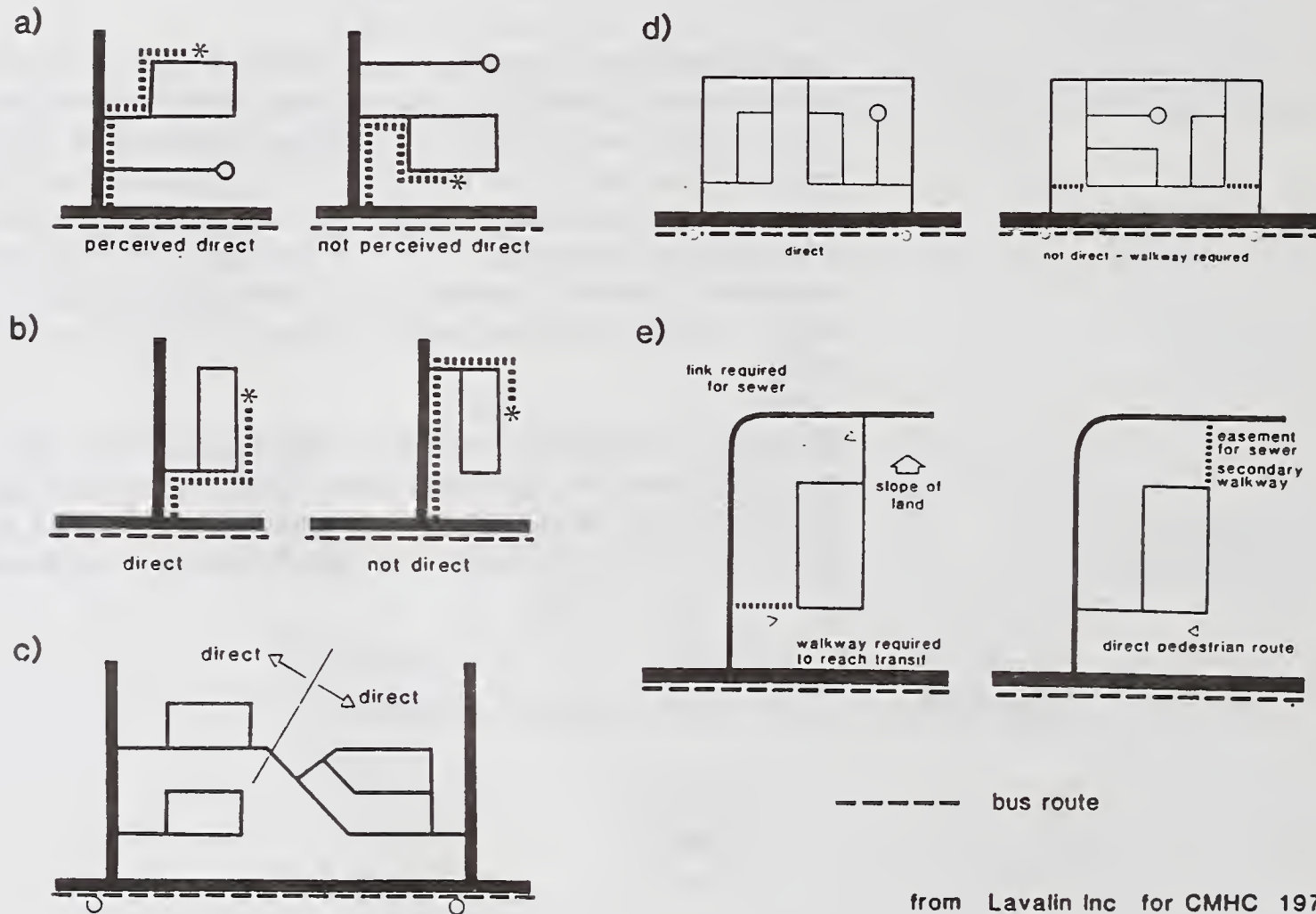
Building location and design should be sensitive to transit-generated noise and views.

The buildings located along a transit corridor can be subjected to the view and high levels of noise if present bus technology is used as a primary transit vehicle. Until quiet vehicles can be designed, building setbacks and design must be planned to accommodate the current noise levels. A 150 foot setback from the transit vehicle lanes between stations for residential land uses is recommended. This distance provides some perceptual 'room', especially if landscaping is used to shield the transitway. Building orientation and territoriality should be taken into account in design. Commercial uses such as offices and retail can be much closer to transit lanes.

The section through the transit corridor should be a linear park-like setting with residential structures set back some distance from the actual transit right-of-way. Retail and commercial uses tied to transit can be located adjacent to transit stops. Extensive landscaping can screen transit vehicles from incompatible uses.

DISTRICT LEVEL/ACCESS SYSTEMS

VARIATIONS ON CURRENT DESIGN PRACTICE TO PROMOTE DIRECT ACCESS TO TRANSIT



from Lavalin Inc for CMHC 1979

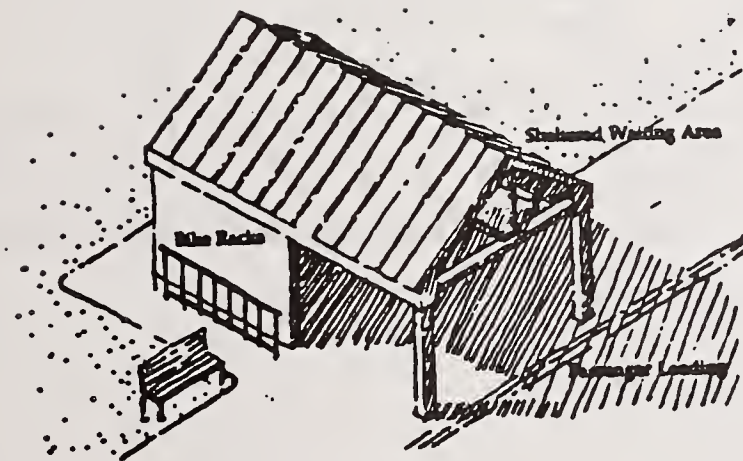
Source: British Columbia, "Guidelines . . .," p. 28.

DISTRICT LEVEL/ACCESS SYSTEMS

Pedestrian/bicycle pathway system.

The design of a transit-sensitive community assumes that the majority of users of the transit service will access to the system by walking or by bicycles. Once transit stop locations are identified and basic land use patterns set, it is important that a strong network of pathways for bicycles and pedestrians be developed. Pathways should be included in the transit corridor parallel to the transit route and radiating from each stop to serve adjacent uses. Pathways should be separated from the roadway and it may be desirable to separate bicycle and pedestrian pathways. Pathways should be a minimum of five feet wide for pedestrians and six feet for bikeways.

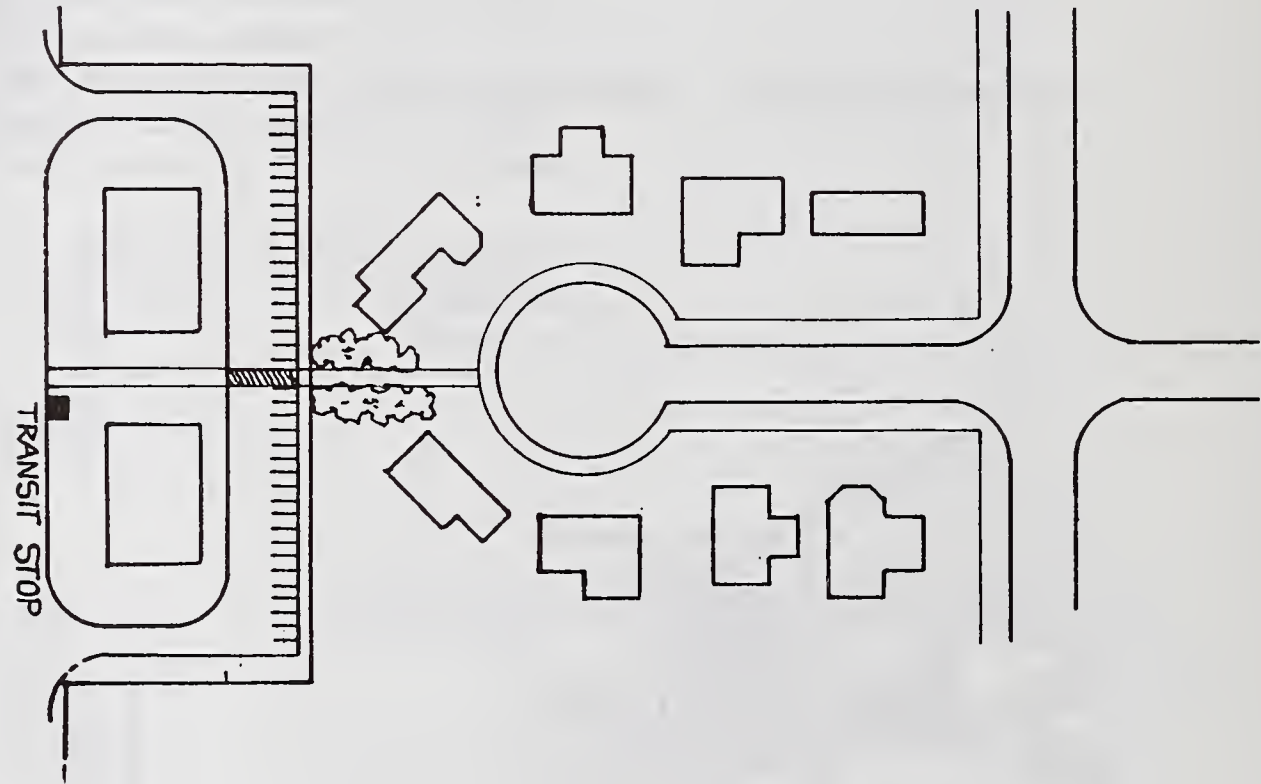
Pathways should be direct but can be combined with open space and access to recreational areas. Open space would ideally be located further from the transitway.²²



²²Calthorpe, "TOD Guidelines," p. 61.

DISTRICT LEVEL/ACCESS SYSTEMS

Figure: Paths facilitate pedestrian and bicycle movement through development to transit stops.

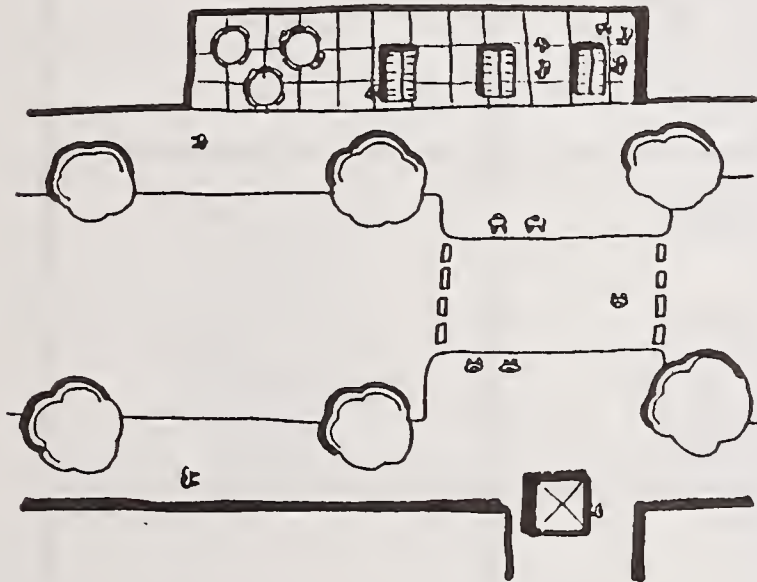


Source: Pace Development Guidelines, p. VI-4 (modified).

DISTRICT LEVEL/ACCESS SYSTEMS

Provide for safe, convenient pedestrian circulation.

Because of the number of patrons who will walk to neighborhood transit stops, pedestrian circulation and access is a prime design consideration. It is also important to combine the transit stops with market-based consumer services.






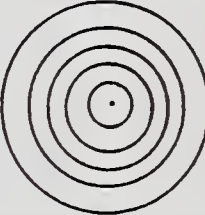


- Pedestrian circulation should be afforded maximum protection by traffic control devices. Streets should be narrowest at pedestrian crossing points to minimize pedestrian/vehicle conflict.
- Pedestrian access points should be close to the expected approach paths and on-street stops.
- Once in the area of a stop the pedestrian paths should be as direct as possible with a minimum of obstructions and conflicts with any vehicular traffic.²³
- Convenience retail services (newspaper boxes, vending machines, banking machines, etc.) should be located at transit stops.

²³Appleyard, p. 275; Petersen, pp. 407, 417; Canadian Transit Handbook, p. 27; IRT Guidelines and Principles, pp. 8, 14; TRB #760, p. 40.

DISTRICT LEVEL/ACCESS SYSTEMS

Pedestrian and Bike Transit Access Distance.

	Average Trip Distance	Average Speed	Average Service Area
Walking	.33 miles 	2 mph 	.34 sq. mi. 
Biking	2 miles 	8 mph 	12.6 sq. mi. 
Biking vs. Walking	6 times distance	4 times speed	37 times catchment area

DISTRICT LEVEL/ACCESS SYSTEMS

Promote bicycle access to transit through high quality pathways and secure storage systems.

Bicycles can be an important element in the success of transit-sensitive land use design. They can substantially expand the market area of a transit station or stop because of higher average distances and speeds of bicycles as compared to pedestrians. A comparison of these differences is shown in the attached figure. As indicated, the average walk distance people walk to a transit station is a third of a mile at an average speed of 2 mph. Bicycle trips are an average of two miles in length at an average speed of 8 mph. This translates into a substantially larger area which can be served by a transit stop. The catchment area of walk access is about one-third of a square mile, while that of a bicycle is 12.6 sq. mile or 37 times that of a pedestrian catchment area.²⁴ A well developed bicycle pathway system adds another significant market element to a transit service. Such pathways should be designed with a high degree of safety and security and or year-round operation.

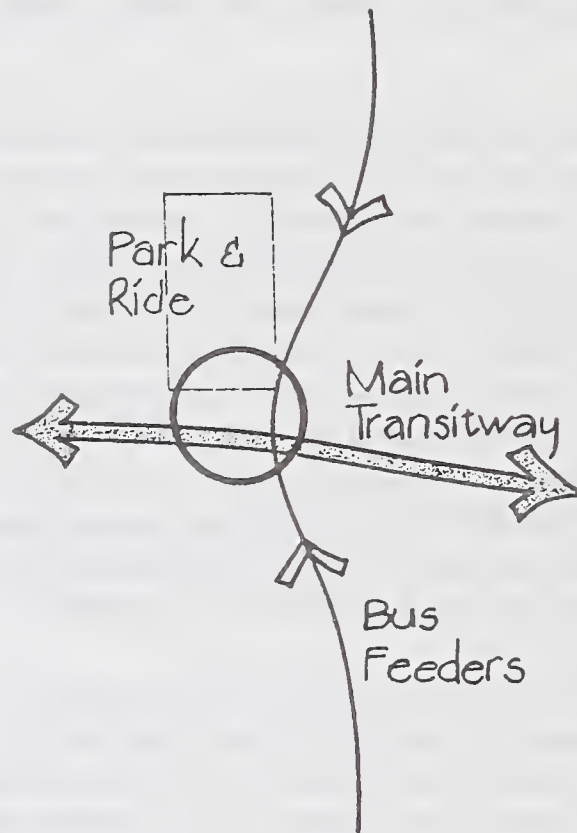
A second element of high quality bicycle access is to provide secure storage for bicycles at transit stops. People who use bicycles should be confident that their bicycles are safe from theft or vandalism in order to use them on a regular basis. This could be done several ways -- through placement of bike racks or lockers at stops or by having bicycle check-in corrals at stops that have associated retail or commercial activity.

²⁴"Trip Reduction and Affordable Housing," Maryland National Capital Park and Planning Commission, March 15, 1990, Silver Spring, Maryland.

DISTRICT LEVEL/ACCESS SYSTEMS

Provide for feeder bus and auto access points.

Although the primary market area for transit will be users in the transit corridor district, the features of the transit services will attract other riders. Park and ride lots as well as feeder transit services will enhance the feasibility of the overall transit system.



- Connections should be direct, short and simple.
- Access can be enhanced by using priority traffic management techniques, making it easier to enter and exit from the station area.
- Sufficient space on some sites must be furnished for any feeder buses (turning radii, parking, etc.) and drop-off areas.²⁵
- Providing market-based services (cleaners, newspapers, shoe repair, auto repair) will enhance ridership.

²⁵Hoel, p. 2; Misek, p. 152; DOT, "Encouraging Public...", p. 35; DOT, "Transit Center-Based Transit Systems...", pp. 35-39; DOT, "Decision Procedures in Transit Station Design," p. 6; TRB #817, p. 37.

DISTRICT LEVEL/TRANSIT SERVICES

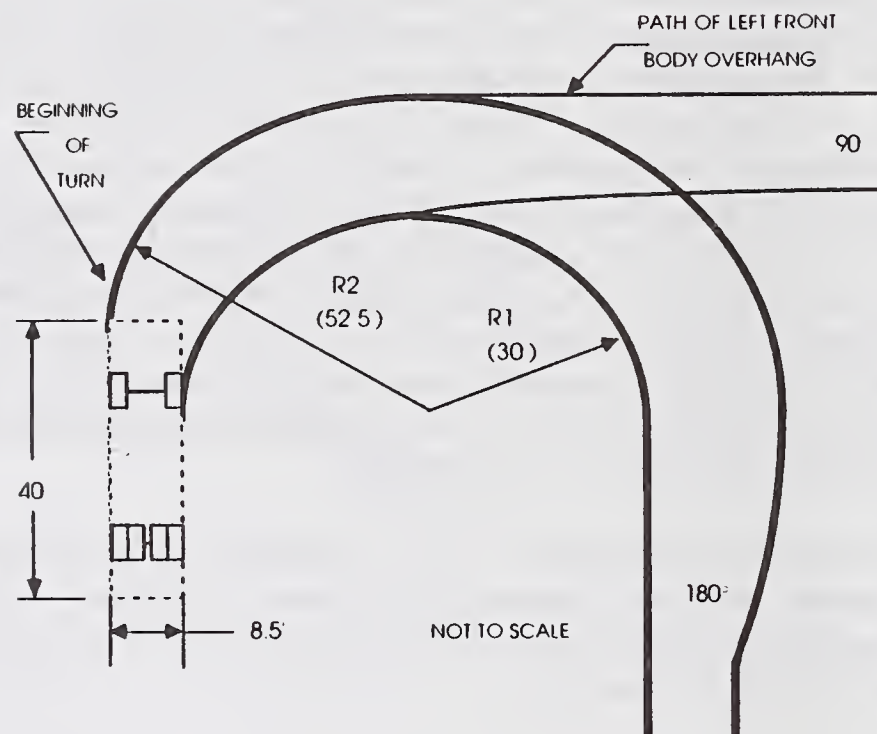
Technological and infrastructure flexibility.

A transit corridor must be able to accommodate various transit modes. It is expected that the transit corridor would initially be used by buses and perhaps even minibuses, however, it should be designed in such a way as to provide options for other technologies. As the market size increases more capital-intensive modes, such as light rail, become feasible. As technological change occurs the right-of-way should be able to respond to such innovation. Thus alignment and placement of underground utilities should permit an upgrading to light rail transit in the future if warranted. Geometric design of transitway components of the corridor should be based on the needs of a rail system rather than bus, including more stringent standards for gradient and curvature than if designed solely for buses. The corridor could be used by a mixture of road based vehicles and services such as a conventional bus, vehicles for the disabled, express services, shuttles, subscription bus, taxis, van pools, etc.. Flexibility should be provided in the design and space available to permit a variety of technological options in the corridor.

Provision for alternative modes and technologies can be controlled through physical design constraints and through regulatory means. The closure of portions of the roadway to through automobile and truck traffic, while at the same time permitting through transit movement, is also recommended.

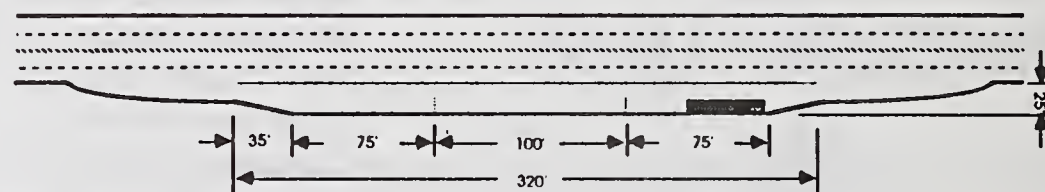


**TYPICAL BUS TURNING
CLEARANCE REQUIREMENTS**

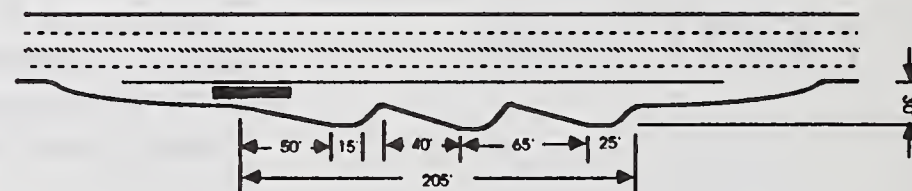


BUS BERTH DESIGNS ²⁶

PARALLEL DESIGN



SAWTOOTH DESIGN



²⁶Source: PACE Development Guidelines.

DISTRICT LEVEL/TRANSIT SERVICES

Provide for high level geometric design of transit corridors.

The design standards for a transit corridor should be set to provide for high speed operation by a family of modes and by multiple services in the same corridor, all of which requires relatively flat curves and low gradients. Design speeds of 50-60 mph would be appropriate to permit operation of express and local vehicles in some segments. Normally spacing between stops would limit operating speeds, however it should not be assumed that all vehicles stop at all stops.

The cross section of the transit corridor should vary in width to accommodate varying land use/parking/stopping and open space patterns. In areas of open space, as when the corridor passes through conservancy areas, the roadway would only need to be wide enough to accommodate two-way traffic with no parking (24-30 feet wide). In developed areas some parking may be added along the roadway resulting in a wider cross-section. At transit stops there should be sufficient width for four vehicles, two stopped and two bypassing the stop. Road cross-sections could also incorporate medians or other lanes as appropriate to a particular site.²⁷

²⁷*Pace Development Guidelines, Seattle Facility Design Guidelines, Anchorage Transit Facility Design Guidelines, Orange County Design Guidelines, Denver RTD Design Guidelines, Alameda-Contra Costa Transit District Facility Standards Manual.*

DISTRICT LEVEL/TRANSIT SERVICES

Provide for handicapped access.

All handicapped persons need access to the transit system. Preferably this should not merely adhere to minimum standards but should be designed for a high level of comfort.



- All public walks should be at least 48" wide with a gradient of not more than 5%.
- They should be constructed as continuing common surfaces not interrupted by steps.
- At least one exit and entrance must be usable by wheelchair patrons.
- Special features should include hand rails, platform edge strips, telephones and ramp designs.²⁸

²⁸Hayduk, p. 93; Institute for Rapid Transit Guidelines and Principles, pp. 53-54.

DISTRICT LEVEL/TRANSIT SERVICES

Provide for passenger safety and security.

The transit stop requires a safe and secure location.

- Provide easily visible safety strips at edge of boarding area.
- Stop signs, crosswalks and control signals should be appropriately used where pedestrian traffic crosses auto and bus traffic.
- Waiting areas should be properly drained to remain clear of water, mud, snow and ice.

Fear of crime may be a substantial deterrent to transit use. Increased ridership will result with the perception that the transit system is a safe system.

- Provide a design that facilitates surveillance of local stops. This includes an "open" design, avoidance of hidden areas and high levels of lighting.
- Local stop stations should be located in areas with frequent automobile and pedestrian traffic.
- Retail and other activities will increase security through the use of "eyes on the street".²⁹

²⁹Newman, "Community of Interest," p. 193.

DISTRICT LEVEL/TRANSIT SERVICES

Provide regular maintenance at transit stops.

General maintenance of stops and shelters should be done on a regular basis. Shelters can deteriorate to a level that detracts from the neighborhood and gives a poor image to the transit system. Glass or plastic panels in shelters should be replaced if it becomes scratched or discolored and schedule/route information should be updated regularly. Graffiti and broken glass should be cleaned or replaced immediately to prevent further damage. Graffiti resistant materials should be used as necessary.

Vending machines, newspaper boxes, public telephones all should be located at transit stops. The transit system should require a high level of maintenance. The transit system should be able to order their removal if poorly maintained.

Advertising may be placed at local stops, shelters or benches if in accordance with transit system policy. Performance standards and/or aesthetic standards may be necessary in the advertising contract in order to maintain a quality image.



IMPLEMENTATION OF THE GUIDELINES

I. Implementation of Guidelines

These guidelines contain many concepts and rules that should be integrated into municipal zoning codes. Some guidelines involve general concepts that require a broad review of the zoning ordinance for improvement, while others necessitate the insertion of a specific regulation. Determining exactly how each of the guidelines can be applied may be time consuming for a municipal staff with many responsibilities. In addition, the number of different guidelines presented may be cumbersome for those trying to add transit to an existing zoning ordinance. The following summary was developed to assist local planners with the implementation of these guidelines in their communities.

Because every local code differs, it is not possible to provide details about where guidelines could fit in a municipality code. However, this summary should assist with the difficult first step towards implementing this report. Key guidelines are included below and suggestions are made for how they can be made legislation.

Zoning should encourage transit-sensitive land use design through the designation of Transit Corridor Districts (TCDs).

This zoning code should accommodate the concept of a Transit Corridor District (TCD). The TCD requires the creation of a new zoning district. The TCD would be similar to a Planned Unit Development (PUD) because it incorporates many aspects found in other zoning districts. The TCD should have transit service as a main objective. Mixed use development should be encouraged and projects in the TCD should have to meet all district level guidelines. The idea of a TCD focuses transit service and develops a separation of land uses that relate well to transit from those that relate to the automobile.

IMPLEMENTATION OF THE GUIDELINES

Provide for transit-sensitive review of site plans and development proposals.

It is important that the needs of transit be considered in the planning review process, since most land development projects are developed with little or no transit input. A transit-based review should be added as a requirement to the development review process in the same manner that landscaping, aesthetics, and utilities are reviewed by many municipalities. This review should cover all developments, even those outside TCDs. If the municipality has a staff person with training in the transit service field, the review can be done in-house. If present staff does not have background in this area, then the local transit agency should consult in site plan reviews. Transit-related concerns must be given serious consideration for all developments.

"A transit-based review should be added as a requirement to the development review process . . ."

Provide a transit checklist for potential developers.

A checklist of transit-based requirements could be used not only as an aid for developers, but the local government could actually adopt it as an official part of the review process. Once a comprehensive, final checklist has been completed in conjunction with the transit agency, a statement such as the following can be added to the zoning code: "All development proposals will be reviewed using the official transit checklist and any other applicable regulations." This statement would be added with the previous guideline. The checklist can be more informally used as a means by which developers are informed of the issues a municipality will consider when reviewing a proposal. The checklist should be reviewed and updated on a regular basis.

IMPLEMENTATION OF THE GUIDELINES

Parking requirements in TCDs should reflect availability of transit services.

Implementation of the parking guidelines requires a general review of the zoning ordinance. Specific parking requirements in a TCD should be covered by provisions for a parking gradient or the provision of different levels of parking based on proximity to transit. Parking requirements in the current zoning ordinance should be reviewed. Most likely, the ordinance has minimum levels of parking that must be provided and changes should be made to lower the minimum number of spaces required in areas where transit is present. There could be two sets of minimums for land outside of TCDs. Minimum levels of parking for land uses that are not compatible with, or near, transit services should be set to accommodate all patrons as auto travelers.

"It is important to take a long range view and to map out where future corridors of transit service will be."

Establish a Transit Management Association to oversee transportation services and land use development along the transit corridor.

Most TMAs are organized and operated by non-government organizations in the region. However, the local municipality can attempt to get a TMA initiated. Local landowners and early developers should be contacted regarding the organization of a TMA. A municipality may provide initial funding for a TMA.

Pre designate a future system of transit corridors.

TCDs and other future main transit routes should be located before development occurs. It is important to take a long range view and to map out where future

IMPLEMENTATION OF THE GUIDELINES

corridors of transit service will be. TCDs should be zoned as entire districts. It could be feasible to add to a TCD if future growth patterns warrant, but the initial rezoning should include all land necessary for the successful development of a corridor.

Separate transit-oriented and auto-oriented land uses.

The separation of transit-oriented and auto-oriented land uses can be accomplished by excluding specific types of land uses from TCDs and areas near transit service. The exclusions should be based on the ability of a land use to be served by transit. For example, a lumber yard should not be a permitted use in zones that can be served by transit. The uses summarized in Appendix A can be a starting point for identifying such exclusions.

"Local governments should consider a proactive approach to development surrounding stops."

Establish transit service zones along existing arterials.

TCDs can be designated along existing, developing corridors. Flexibility must be incorporated into the TCD if existing developments are present. If a TCD zone has been established in a partially undeveloped area, it may be necessary to create two districts, TCD-1 and TCD-2, with one zone more permissive of older developments.

Explore public/private opportunities for transit stop joint development.

A most opportune location for joint development by the private and public sectors is at transit stops. Local governments should consider a proactive approach to

IMPLEMENTATION OF THE GUIDELINES

development surrounding stops. Large stops can become part of the surrounding buildings. Developers may pay to construct sheltered stop areas that tie directly to their buildings and revert the actual right-of-way to the municipality. The main benefit for the developer is the increased patronage that will flow from the transit stop directly into the building. For the municipality, capital costs are reduced.

At smaller stops, simple retail services can become part of joint development efforts. The presence of retail services at transit stops can be contracted out to businesses for different services. This also allows small businesses to become established in each neighborhood. Another alternative is to seek joint development opportunities with private companies. In return for providing some of the needed funds to develop the transit stop, a private firm is allowed to use the adjacent land for retail service provision.

"The designation and official zoning of a Transit Corridor District (TCD) is the first step toward implementing transit service."

Design for a phased implementation of transit corridors.

The designation and official zoning of a Transit Corridor District (TCD) is the first step toward implementing transit service. The municipality should develop standards by which the corridors' growth will be measured. After growth in population and building has occurred, additional service should be added. The additional service should include the improvement and expansion of transit stop facilities. The municipality should develop a schedule, based on the amount of development, showing when upgrades will be made to services and stops.

IMPLEMENTATION OF THE GUIDELINES

Control of through automobile traffic.

Successful TCDs could generate large amounts of automobile traffic and will interfere with the ability to provide high quality transit service. It would be very difficult to close an existing roadway after substantial development has occurred. Early location of no-auto zones along the transit route before development is critical and will limit automobile interference. These can be protected through official mapping and/or the zoning map.

Use corridor for primary pedestrian, bicycle and transit movement.

"The zoning code and site review process should be modified to assure that there is a provision for separate, high quality, pathways for pedestrians and bicycles."

The zoning code and site review process should be modified to assure that there is a provision for separate, high quality, pathways for pedestrians and bicycles. All cul-de-sacs should include pathways at their ends to connect to surrounding streets. Logical pathways should be provided to provide direct connections for between different parts of developments. Sufficient rights-of-way should be reserved (through official mapping) to permit separate, parallel bike and pedestrian paths along transit corridors and arterials within transit service zones.

Transit vehicles should be quiet and have low air pollution levels.

Develop standards for the purchase of quality transit vehicles. Improvements in the development of quieter vehicles, cleaner burning engines, and comfortable vehicles are necessary to attract ridership.

IMPLEMENTATION OF THE GUIDELINES

Identity: Signage and compatibility of stops.

Local governments should establish a set of standards for transit stops. The standards must fit with the character and needs of the individual community. They should be officially adopted and used in the design of each stop.

Provide mixed land use including housing, office, retail, light industrial and recreational uses.

This guideline would be implemented by developing special zoning categories at transit stops. Larger projects would be encouraged that contained a ratio of uses (for example, a ratio of office space to residential units, with flexibility. Single parcel, mixed use developments provide better interaction between different land uses than separate, adjacent parcels with different land uses. Another option would be to zone on a small parcel level to ensure a variety of compatible uses adjacent to one another.

Land use density gradient.

Radiating from the transit stop, different density zones should be established. Development within the zone closest to the transit stop should have minimum density levels that are fairly high for both commercial and retail uses. The first zone should extend approximately 1/8 mile from the transit stop. The subsequent zones should step down in density levels. Beyond 1/4 mile from transit service, densities should be lowest. Even with high density minimums in some areas, maximum density levels

IMPLEMENTATION OF THE GUIDELINES

also should be adopted to prevent development that does not fit the character of the area. These density zones should be adopted as part of the TCD zoning.

Relate the design and connections of adjacent developments across 'seams'.

The ability to tie together individual development projects is critical to the success of a Transit Corridor District. Developers should be allowed considerable flexibility in their planning within a project; however, project review and stipulations must assure that adjacent developments fit together. Conditions that should be met include maintenance of the continuity of transit roadways, circulation between adjacent properties, provision of easements on rights-of-way for pathways and appropriate adjacencies of land use.

"... project review and stipulations must assure that adjacent developments fit together."

Parking density gradient.

A parking gradient should be regulated which is similar to the density gradient. Development closest to transit stops should have little or no parking. Development located further from transit should have more parking spaces present. The zoning should utilize the same 1/8 mile zones as the density gradient. Again, each zone should have both a minimum and maximum parking space requirement. Current parking requirements in suburban codes would most likely apply only outside TCDs and away from transit service.

IMPLEMENTATION OF THE GUIDELINES

Develop a program to encourage shared parking facilities.

To encourage the use of shared parking lots, the municipality should require each proposed project to identify all parking facilities on adjacent parcels and explore the feasibility of their use as shared lots. Local government also could approve development proposals on the condition that the land owner sign an agreement stating that they will arrange for joint use of parking facilities whenever deemed feasible by the municipality.

"A basic tenet that should be implemented in the zoning/building code is that pathways should be provided between transit stops and building entrances."

Minimize the distance between building entrances and transit stops, provide logical connections between buildings and transit.

A basic tenet that should be implemented in the zoning/building code is that pathways should be provided between transit stops and building entrances. This is seldom done in suburban areas; often it is necessary for a user to walk across lawns or through parking lots to reach a building. This regulation also would specify a maximum walking distance from transit stops to building entrances.

Building location and design should be sensitive to transit-generated noise and views.

This guideline can be easily adapted to a zoning code. Either the municipality can maintain a very large right-of-way along the transit path, or building setback requirements can be regulated to keep residents removed from the sight and noise. Setbacks should be greater near transit stops for residential buildings where vehicle acceleration and braking noise is loudest. Commercial buildings can be permitted

IMPLEMENTATION OF THE GUIDELINES

to be closer to the transit line than residential uses. In addition to the increased setback distances, trees and berms can be used to block the view of the transitway. Local government should have a policy of maintaining tree plantings along the transit rights-of-way.

Technological and infrastructure flexibility.

Local governments should retain a right-of-way width along the transit line that can handle changes to the system that may need more space. Also, space for any transit corridor crossing paths should be reserved. The transit service should be periodically evaluated to determine if ridership is high enough to warrant an upgrade in the type of transit service. The transit agency should set up review standards and a proposed time schedule for this review. Transit service should be able to be converted to improved vehicles if they become available.

" . . . show how pedestrians and bicycles will be able to cross the property and how the pathways will connect into the overall pathway system."

Pedestrian/bicycle pathway system.

As part of the TCD, a pathway system of public rights-of-way should be developed within its boundaries. This system should be mapped out and be designed with area-wide connectivity. Private developments also should become part of this system. The municipality would require each developer to submit a pedestrian/bicycle pathway plan. The plan should show how pedestrians and bicycles will be able to cross the property and how the pathways will connect into the overall pathway system. All cul-de-sacs should have pathways that lead from their ends to adjacent streets. The municipality should maintain an updated pathway system map.

IMPLEMENTATION OF THE GUIDELINES

Provide for feeder bus and auto access points.

This guideline requires some type of transit station or parking area to be used by the transit service. Feeder bus service should be at a major stop along the transit corridor. On the other hand, the park and ride facilities should be located away from the larger, dense stops. If feasible, park and ride lots may utilize some type of shared parking facility. Developments with large parking areas should be required to include sufficient space for bus movements in case future park and ride or feeder service becomes practical on the site.

PROTOTYPE DESIGN/INTRODUCTION

PART III: PROTOTYPE DESIGN

These concepts and guidelines described earlier were used to develop a prototype design for an emerging suburban area located west of the City of Milwaukee. This was done to illustrate the concept and to test how the guidelines could be applied to a real world situation. The process of developing the prototype design and the guidelines occurred simultaneously and there was substantial modification of both as the project progressed. All members of the project team participated in the design process and the result represents the collaborative effort of all involved.

The design evolved through three stages. First, a theoretical design was developed to attempt to illustrate how the concept of a Transit Corridor District would look without site constraints. In the second stage, the initial prototype design was modified to address the conditions on a specific site. Finally, in the third stage, this design extensively critiqued and a final design was developed.

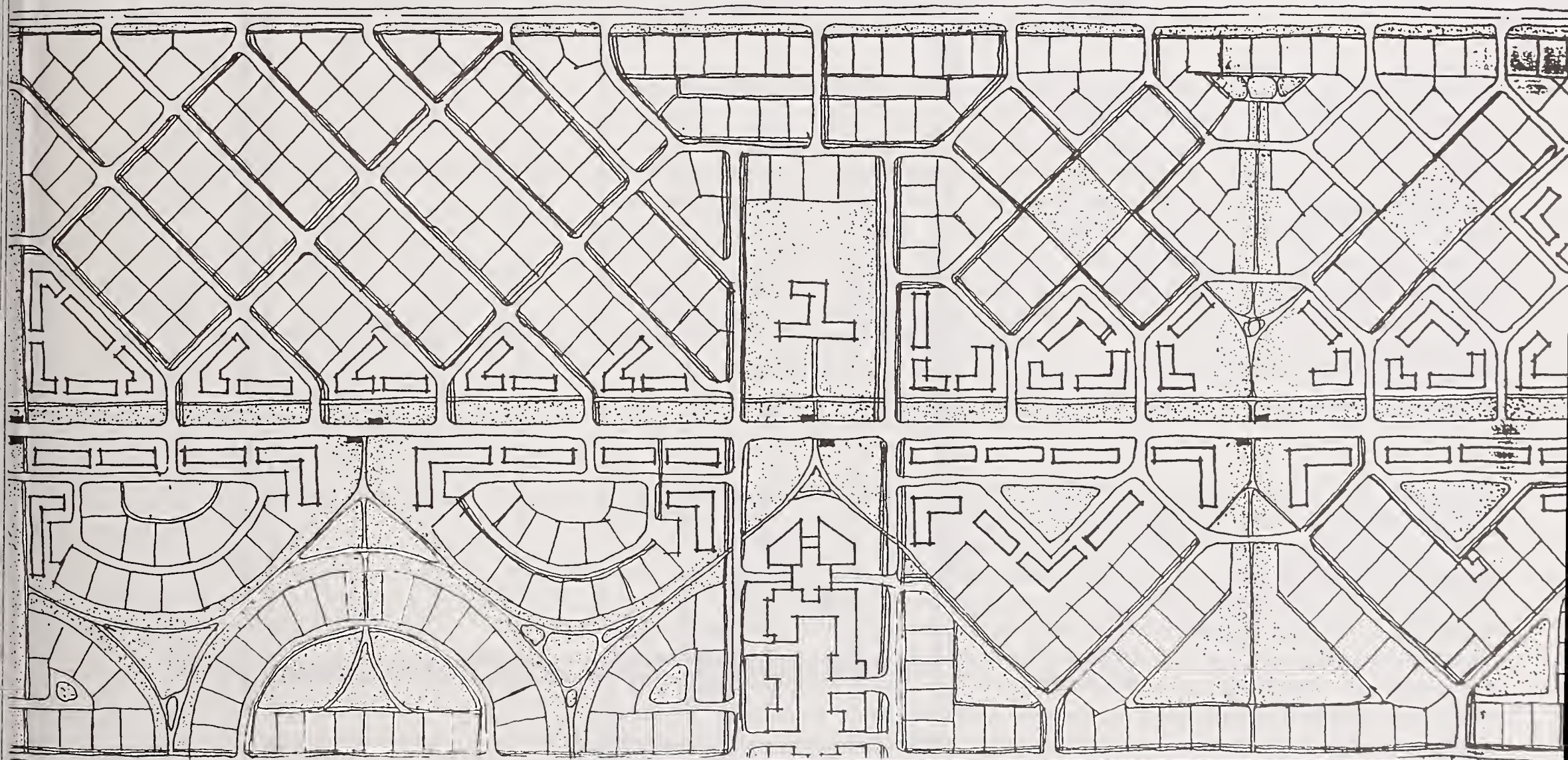
J. Theoretical Development

Theoretical Designs

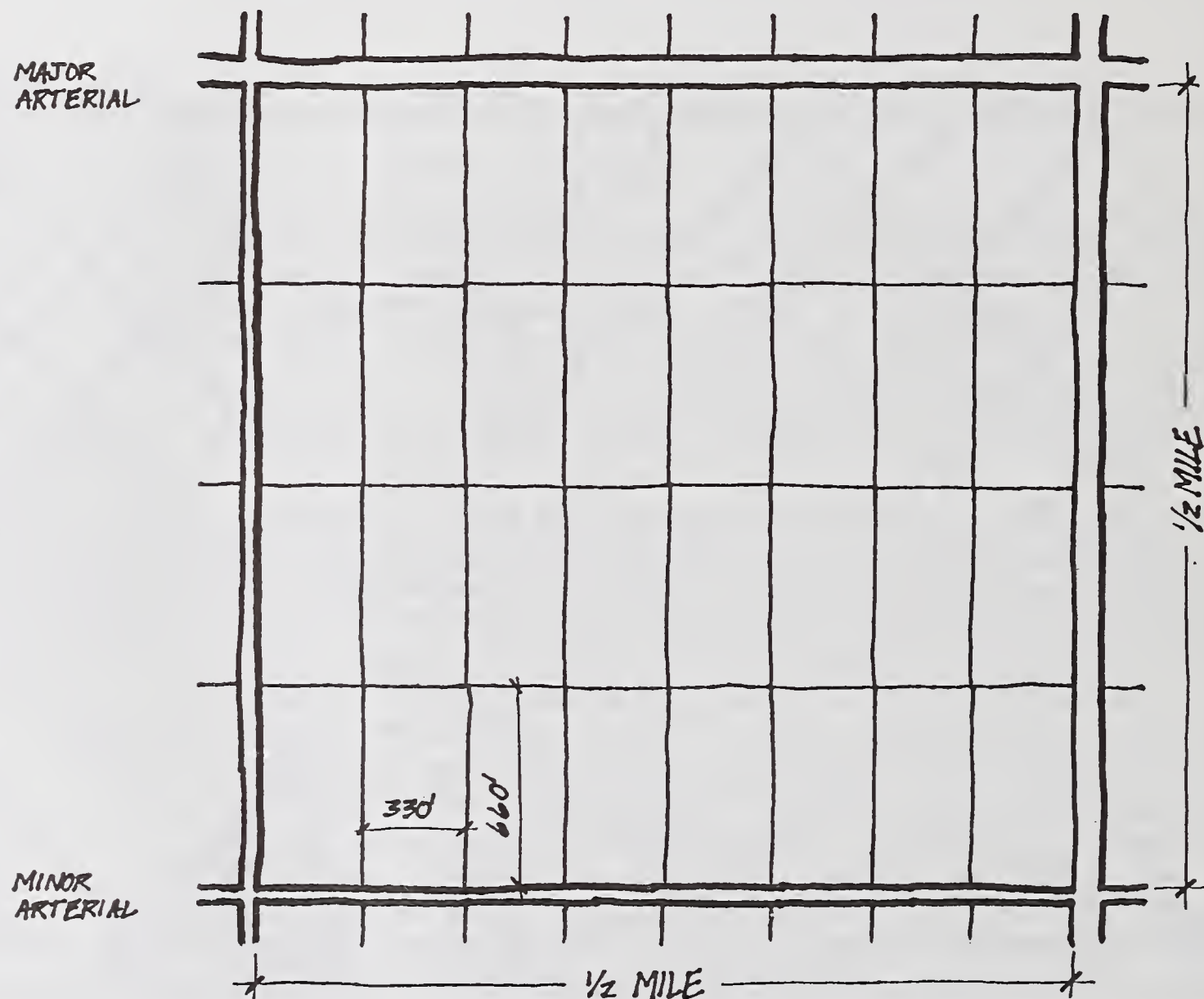
Initial work on the project focussed on the development of overall concepts and preliminary design work. The basic concept that emerged was a corridor based land use pattern following a transit route. Ideally the transit corridor would be located parallel to a primary highway arterial, but at least 1/4 mile away to create a zone of pedestrian access to the transit system. The starting point then simply was a line on a piece of paper representing a transit route. A 1/4 mile stop spacing was added along with a series of pathways to connect the stops to surrounding areas.

A one-half mile by one mile segment was developed next. This includes a central transit route and a local street and block pattern designed to provide direct walking paths to the individual stops. Higher density land uses (apartment buildings, offices, etc.) are placed directly along the transit route. At the center of the area a school is located near the transit stop with open space located behind it. A shopping center is also located at the center. It is different than a typical shopping center in that it occupies a long, narrow site. Transit-related shopping (neighborhood stores, etc.) is located nearest the transit stop while auto-related shopping is located along the auto arterial street. Green space is included along the pathway system to provide some open space and to somewhat isolate the noise of transit vehicles from surrounding areas. Four alternative street and block patterns were used in the quadrants of the area. These were located following the location of the pathways and reflect a desire to minimize walking by providing diagonal pathways. Different patterns were used in each quadrant to show the range of options that could be used.

PROTOTYPE DESIGN/INTRODUCTION



PROTOTYPE DESIGN/INTRODUCTION



BASIC MILWAUKEE GRID

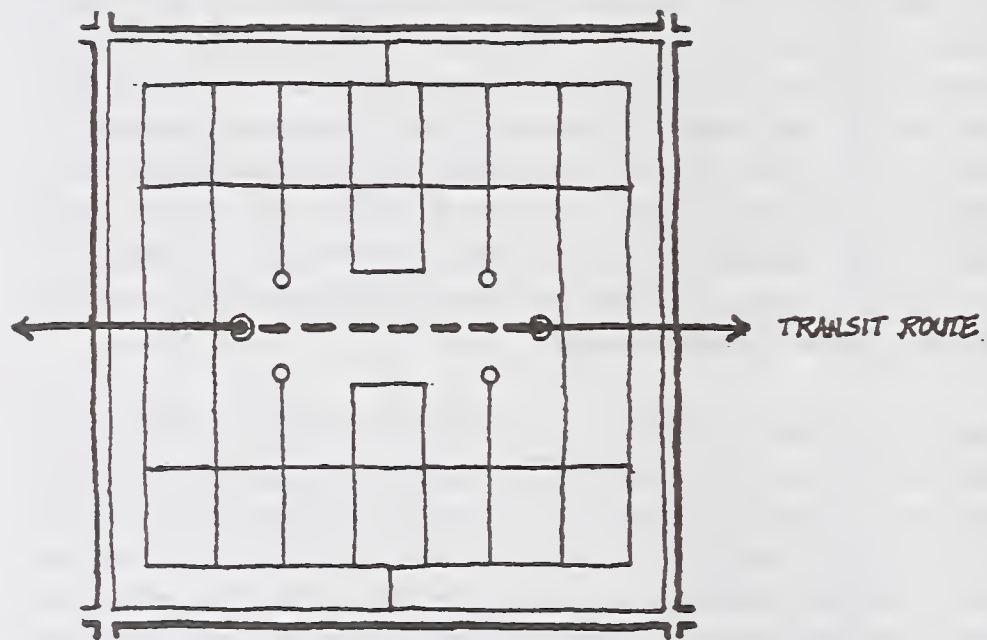
PROTOTYPE DESIGN/INTRODUCTION

Local Street Patterns: Variation on a Grid

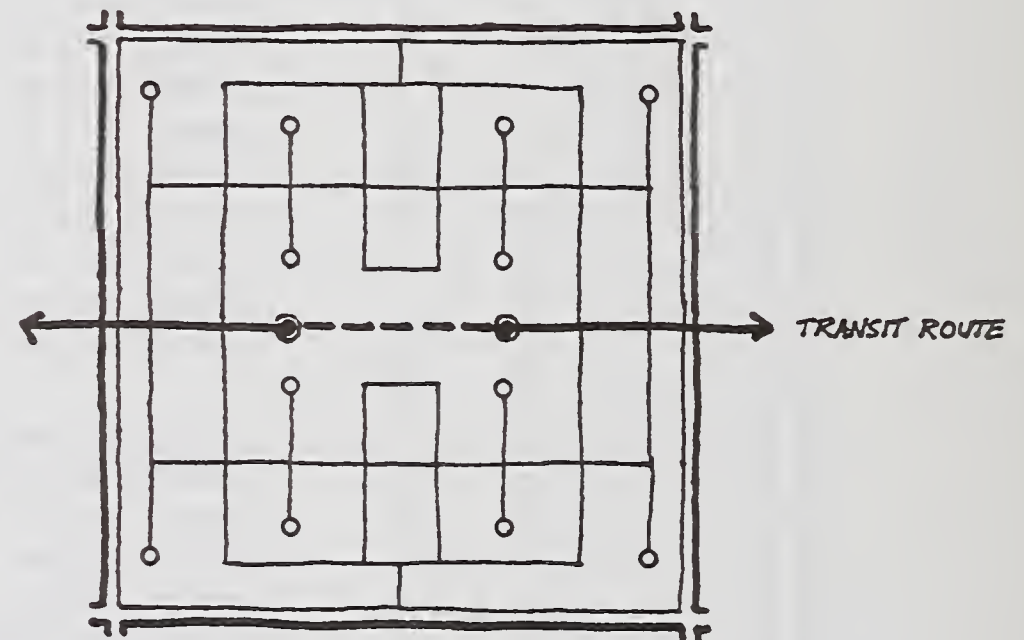
Another effort that provided some useful insight was to examine how a traditional grid street pattern could be modified to provide a transit-sensitive land use pattern. The basic "Milwaukee grid" was used as a starting point. This pattern is found in the older parts of the City of Milwaukee and has 16 blocks to the mile in the east-west direction and eight blocks per mile in the north-south. Arterial streets are designated every one-half mile leading to an area 1/2 mile on each side with 32 blocks. Each individual block is of a size of 660 by 330 feet (including street rights-of-way) and can contain 20 lots if the lots are 60 feet wide. This results in a residential density of 2560 lots per square mile or 5-10,000 persons per square mile with single family dwelling units and typical household sizes. Actual densities, of course, vary depending on other land uses, differences in lot sizes, household size and the presence of multifamily housing. Such a pattern provides a high density of land use that should be sufficient to support transit service.

Grid street patterns have significant problems in urban areas and are avoided by planners in modern land use design. Through traffic can be a significant problem since it is relatively easy to take shortcuts through residential neighborhoods and to avoid congested arterials by using parallel local streets. Residential or commercial lots that directly front along arterial streets also cause problems for traffic operations along the arterials because of conflicts with vehicles turning in or out of driveways. Another problem occurs if grid streets are placed in areas with difficult terrain. Gradients on streets become too steep as streets go up high slopes. Furthermore it can be difficult to locate building sites along steep streets. However, grid street patterns have some advantages when applied to transit-sensitive land use design. Pedestrian pathways can be direct and high residential densities can be developed.

PROTOTYPE DESIGN/INTRODUCTION



VARIATION A
GRID WITH LIMITED ACCESS TO ARTERIALS



VARIATION B
GRID WITH CUL-DE-SACS

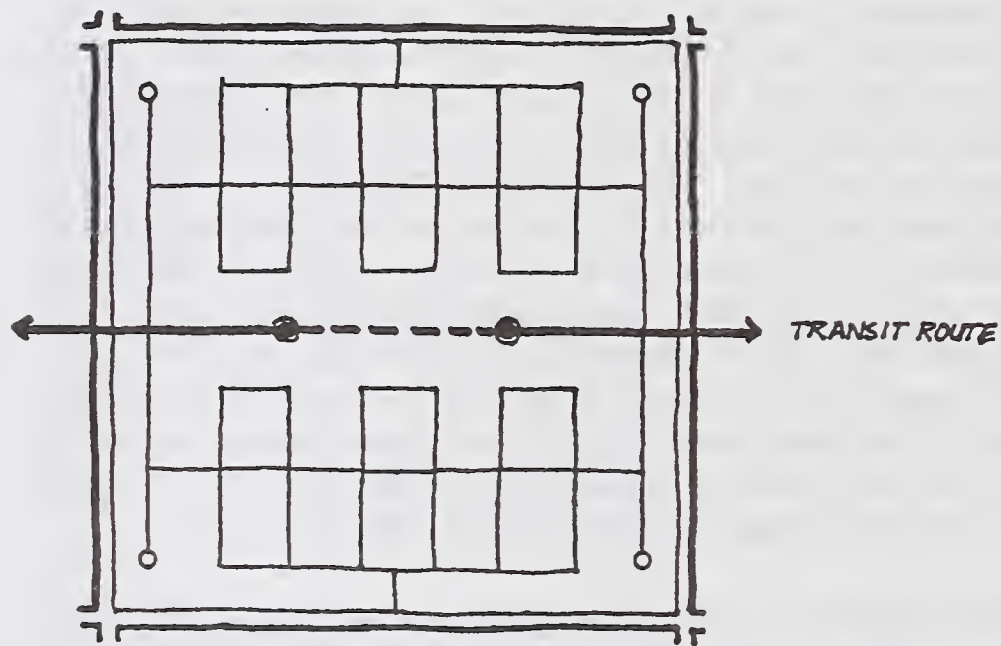
PROTOTYPE DESIGN/INTRODUCTION

Block size and spacing seems to be quite appropriate with transit service built around 1/4 mile walking distance and 1/4 mile block spacing. Thus it may be possible to adapt the grid pattern to deal with some of its problems and to better work with transit systems. Several variations on the grid were done to provide a framework for further design.

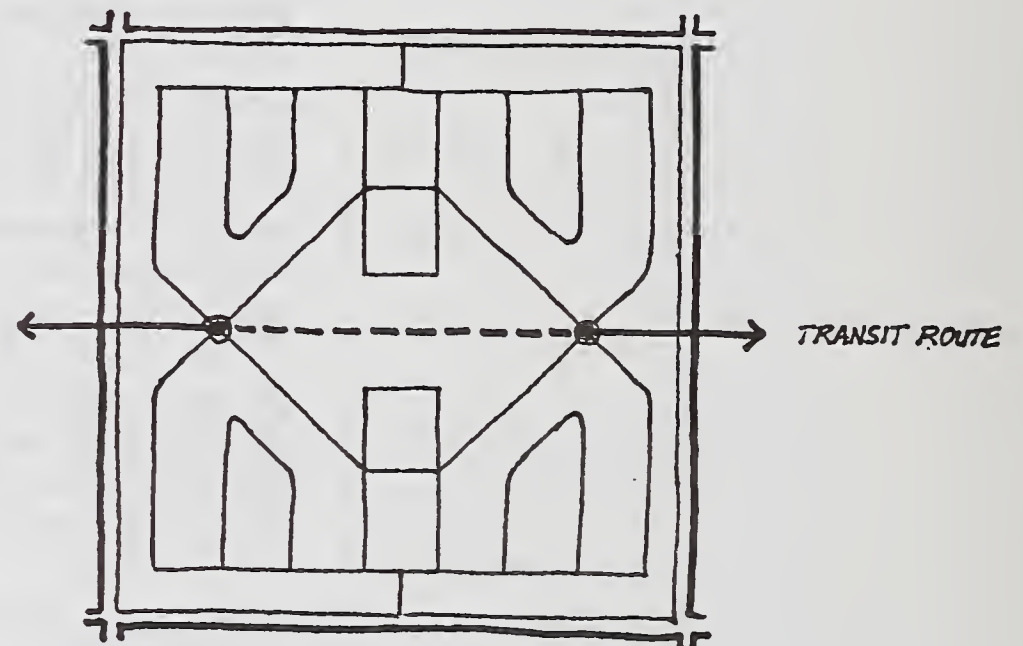
The first variation (A) attempts to control through traffic problems by shifting the interior streets by one-half block and closing off some connections to the arterial streets. Connections to arterials occur at the 1/4 mile points. The transit corridor is located 1/4 mile from the arterial street with stops located internally approximately 1/8 mile from the arterials on the edge. The central portion of the transit route is closed off to automobile traffic and pathways are used to provide connections to the transit stops. Other variations on this theme could involve more extensive use of cul-de-sacs (B) and loop streets (C). Diagonal streets could also be used internally to provide direct walking paths (D). The configuration of streets also depends on the general direction of the transit route relative to the grid. A transit route running parallel to the long side of the blocks would result in a different pattern of streets (E). In this case the transit route could be located entirely separate from the local street system or else it could be shifted one half block to follow the streets.

The placement of streets where two transit corridors cross presents interesting opportunities (F). Such a place would be a natural location for concentrated shopping and office activity. These areas could be spread along the two transit routes and it is likely that stops would be placed close together. The restriction of auto traffic opens up the center of the commercial area for extensive pedestrian movement and for public space for civic activities. Parking for automobiles could be provided along the outside of the commercial district on all sides along with good access from the surrounding arterial streets. Further variations are possible,

PROTOTYPE DESIGN/INTRODUCTION



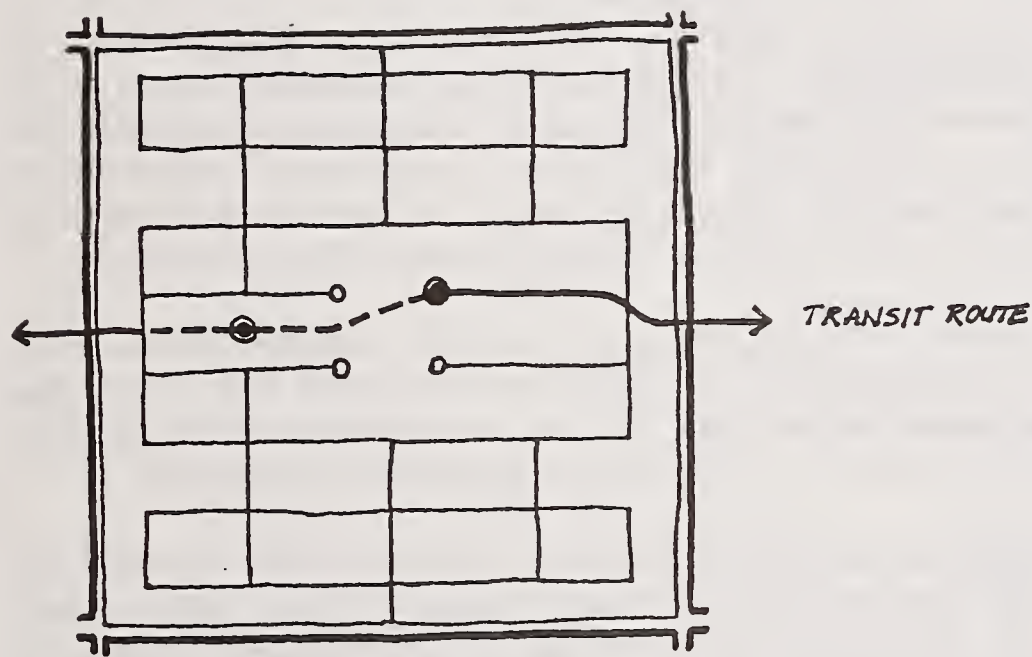
*VARIATION C
GRID WITH LOOP STREETS*



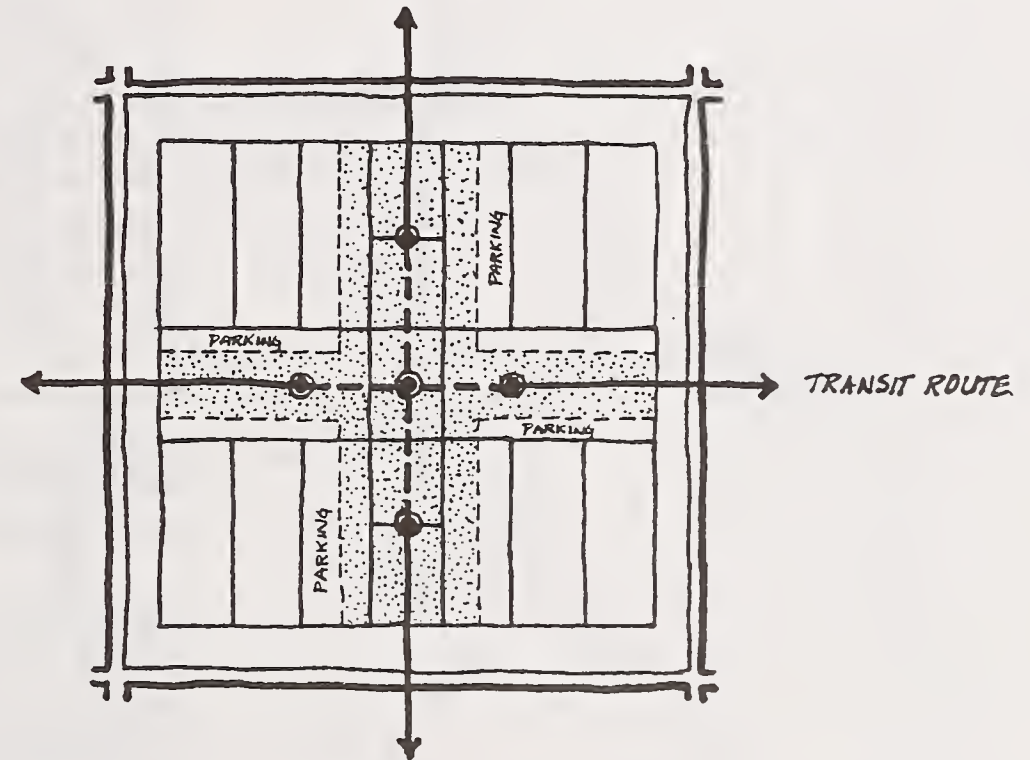
*VARIATION D
USE OF INTERNAL DIAGONAL STREETS*

PROTOTYPE DESIGN/INTRODUCTION

especially the introduction of curvature in the street pattern and the reduction of symmetry. The basic structure of streets, however, should include location of the transit corridor and stops to provide good pedestrian and bicycle access and to control automobile movement to avoid interference with safe and efficient transit and pedestrian circulation.



VARIATION E
TRANSIT ROUTE PARALLEL TO LONG SIDES OF BLOCKS



VARIATION F
COMMERCIAL DISTRICT AT THE INTERSECTION
OF TWO TRANSIT CORRIDORS

K. Site Description

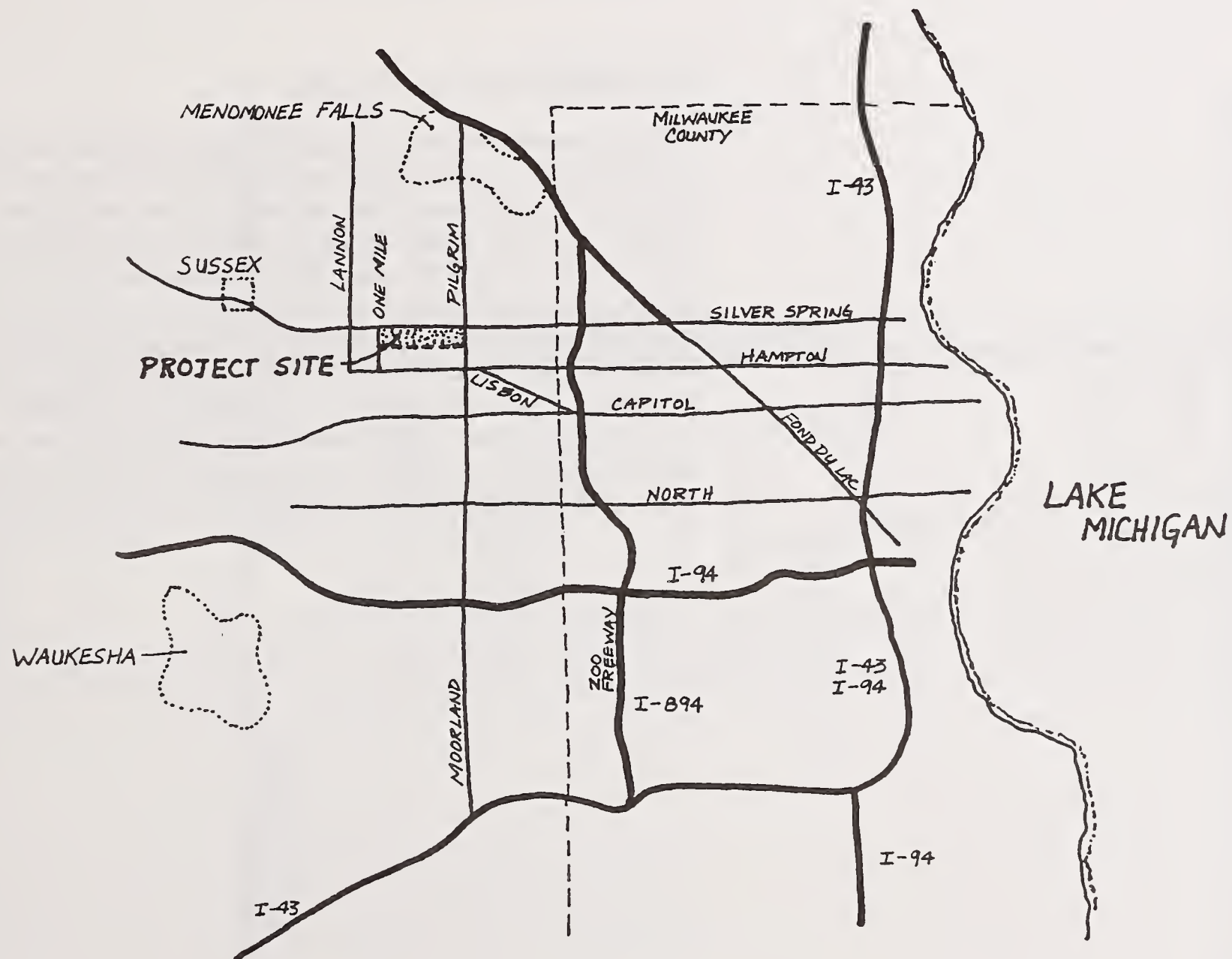
Selection of the Project Site

To test our guidelines and concepts a prototype design was developed for a suburban area. The site chosen is one-half mile wide by two miles long and is located west of the City of Milwaukee in the Township of Menomonee Falls. The area is rural in character with little development. However, urban development activity is occurring south and north of the site and it is likely that it will see a transition from rural to suburban land use in the near future. It lies north of the City of Brookfield and south of the Village of Menomonee Falls, both of which have had substantial suburban development during the past twenty years. To the east is an industrial district while three miles to the west is the rapidly growing Village of Sussex.

The site chosen is parallel to Silver Spring Drive, a major east-west arterial which connects to the U. S. Highway 45 belt freeway two-and-a-half miles east. The comparable arterials located to the south (Capitol Drive, North Avenue, and Blue Mound Road) have been sites of substantial commercial strip development.

The selection of this site was based on its potential for future suburban development activity. In addition, it appeared to be a potential location of transit services which could connect into the Milwaukee central area and provide an east-west crosstown service into the City of Milwaukee. Because the site is relatively undeveloped and has relatively few owners, there are opportunities to provide concentrations of demand that could create a significant market for transit services. Finally, the site has a mixture of rolling terrain and natural features which could be incorporated into the design.

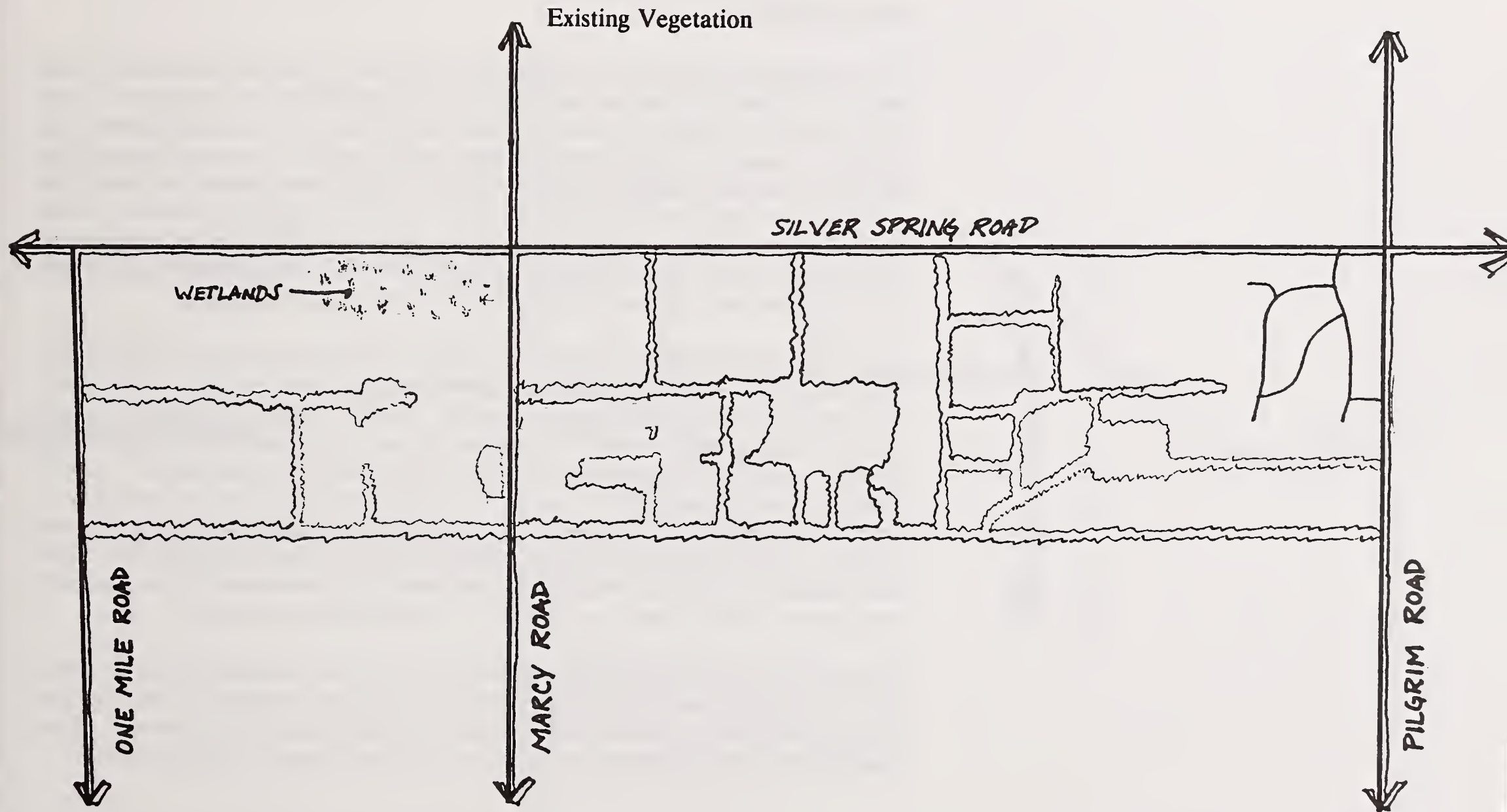
PROTOTYPE DESIGN/SITE



Site Conditions

The site consists of gently rolling hills with no significant slopes which would impede development. Current use is agricultural with a few scattered residences. There is a large wetland located in the northwest corner of the site. There are some wooded areas in the site, primarily in the form of mature fence rows with some larger wooded tracts in the south-central and west portions of the site. Land ownership is primarily in large parcels up to 80 acres in size. The east edge of the site is along Pilgrim Road, a major north-south arterial in Waukesha County which connects the Village of Menomonee Falls with a major regional shopping/office center at Brookfield Square to the south. The next north-south street is Marcy Road, one-and-one-half miles west. Marcy Road is two miles long and does not directly continue across the county. Another major arterial, Calhoun Road, a mile west of Pilgrim Road, could potentially be extended through the site in the future.

PROTOTYPE DESIGN/SITE



Transit Service

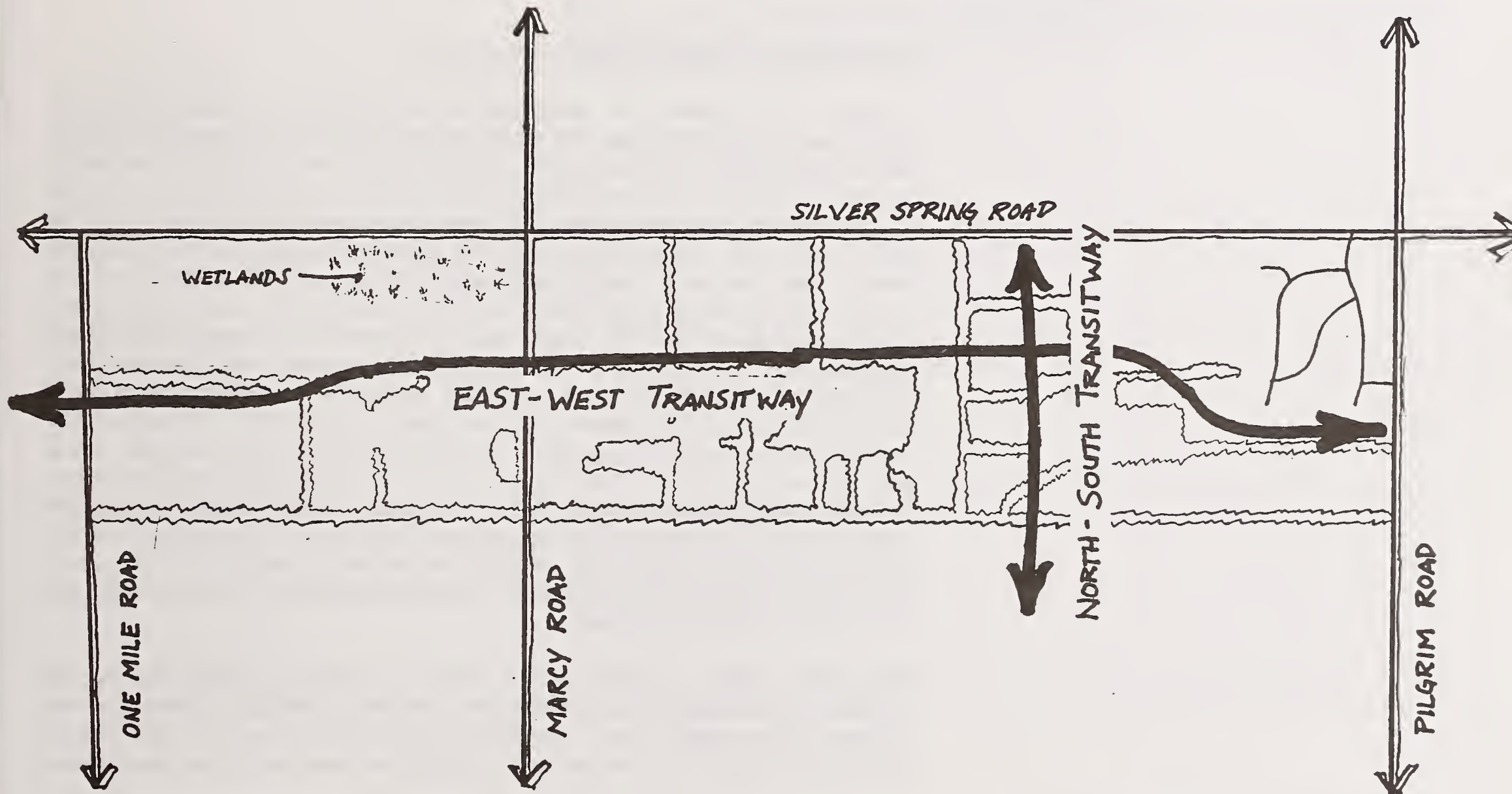
It was assumed that there would be two transit routes that would intersect in the district. An east-west line that parallels Silver Spring Drive and a north-south route that connects the suburban centers of Menomonee Falls and Brookfield Square. Our primary emphasis is on the east-west line, which could be extended westward an additional two miles before it would encounter existing development and have to be rerouted to along Silver Spring Drive. The intersection of the two routes presented an opportunity to create a town center for shopping and office activity built around the transit services. No substantial shopping districts exist nearby and this appeared to be a logical use which would work well with the transit service.

The east-west transit route was located roughly 1/4 mile south of Silver Spring Drive. The route was located to avoid steep gradients and to parallel fence line wooded areas so they could be used to enhance the corridor. The north-south route was assumed to be along a corridor that passes through open space north and south of the site, eventually connecting with Pilgrim Road and/or Calhoun Road. A north-south transitway intercepts this site in its "downtown" area. This line connects the Brookfield Square/Blue Mound Road, a strong area of suburban employment and shipping, with the growing Village of Menomonee Falls, north of the district. Other route locations in this area which were not selected include areas of wetlands, parks and quarries, built-up areas and areas of outstanding natural beauty.

Transit stops were located approximately every 1/4 mile along the corridors with a closer spacing in the town center. Generally stops were located 1/8 mile in from crossing arterials to provide for reduced walking distances to transit. Some modification of stop locations were made to take advantage of site conditions.

PROTOTYPE DESIGN/SITE

Location of Transit Service



L. Prototype Plans

Initial Prototype Transit Corridor District Plan

A plan for the corridor was developed midway through the project to help in developing the guidelines and help illustrate some of the design concepts. This is shown in the figure. The eastern part of the corridor contains a town center with a mixture of retail, civic and commercial activities. Housing for the elderly as well as one and two bedroom apartments for young people would also be located in the town center area. To the west, there is a pattern of mixed land use along the corridor with a mixture of multifamily residential and small offices located directly along the transit route. Single family housing on relatively small lots are provided in the several blocks from the transit route. Extensive use is made of the natural features. Most wooded areas are retained as part of parks and nature preserves and the pathway system that connects residential areas to the transit route. Wetland areas are retained and in some cases converted to open water and storm water retention areas. A elementary school site along with an outdoor recreation area is provided near the center of the corridor. A strip type shopping center is located on the west of the site near the open water. It is expected that it would be served by both automobiles and transit with auto-oriented shopping on the north side, near the arterial, and transit-related, local shopping located on the south side of the parcel. The corridor roadway would be closed to automobile traffic in the town center and at one other location to the west.

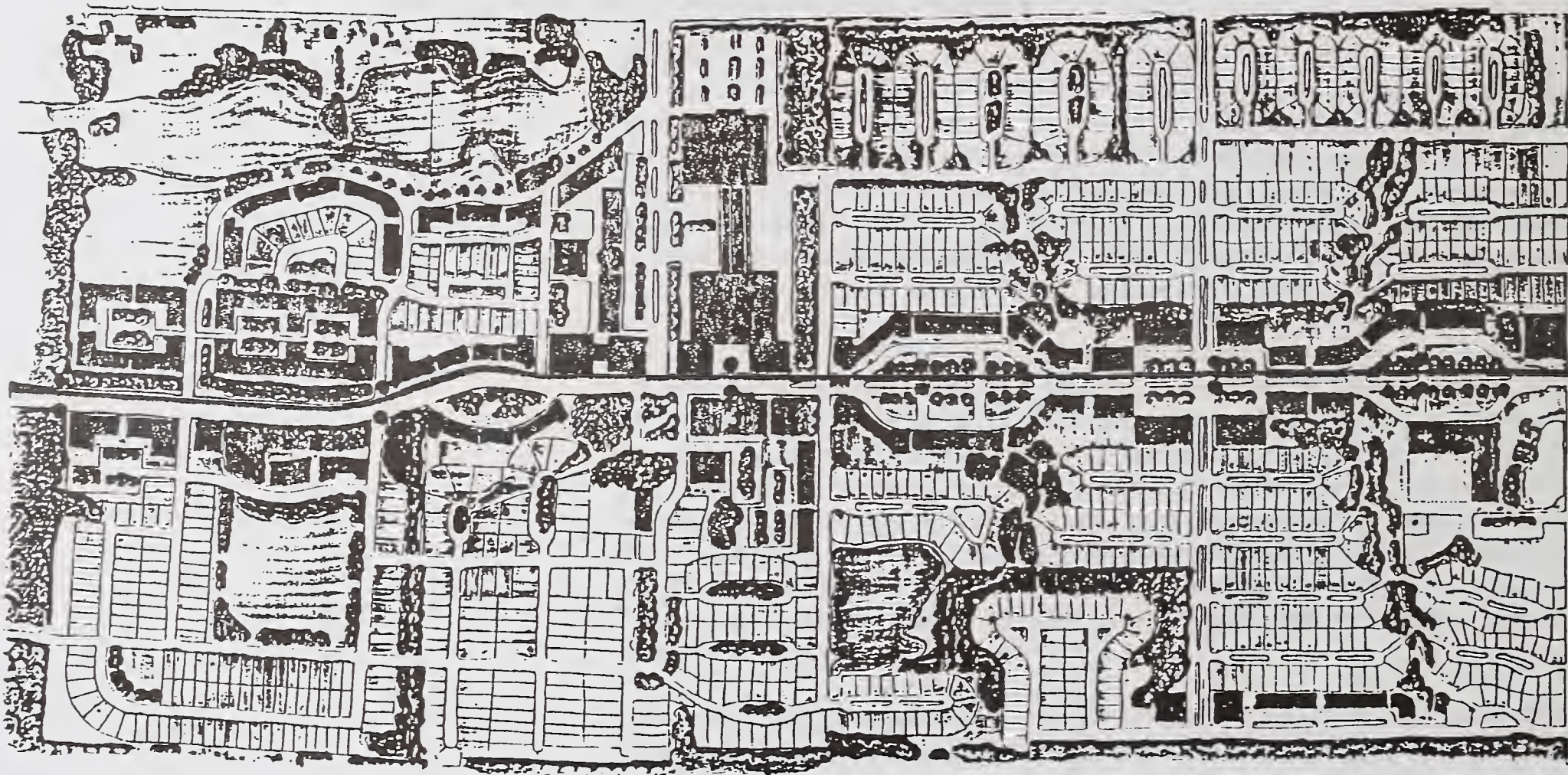
This initial design provided a useful exercise in applying and developing the guidelines. Following its completion it was extensively critiqued to determine how a revised design might look. The design was evaluated based on the criteria developed to judge ICDC entries and exemplars as described in the *New Suburbs*

PROTOTYPE DESIGN/RESULTS

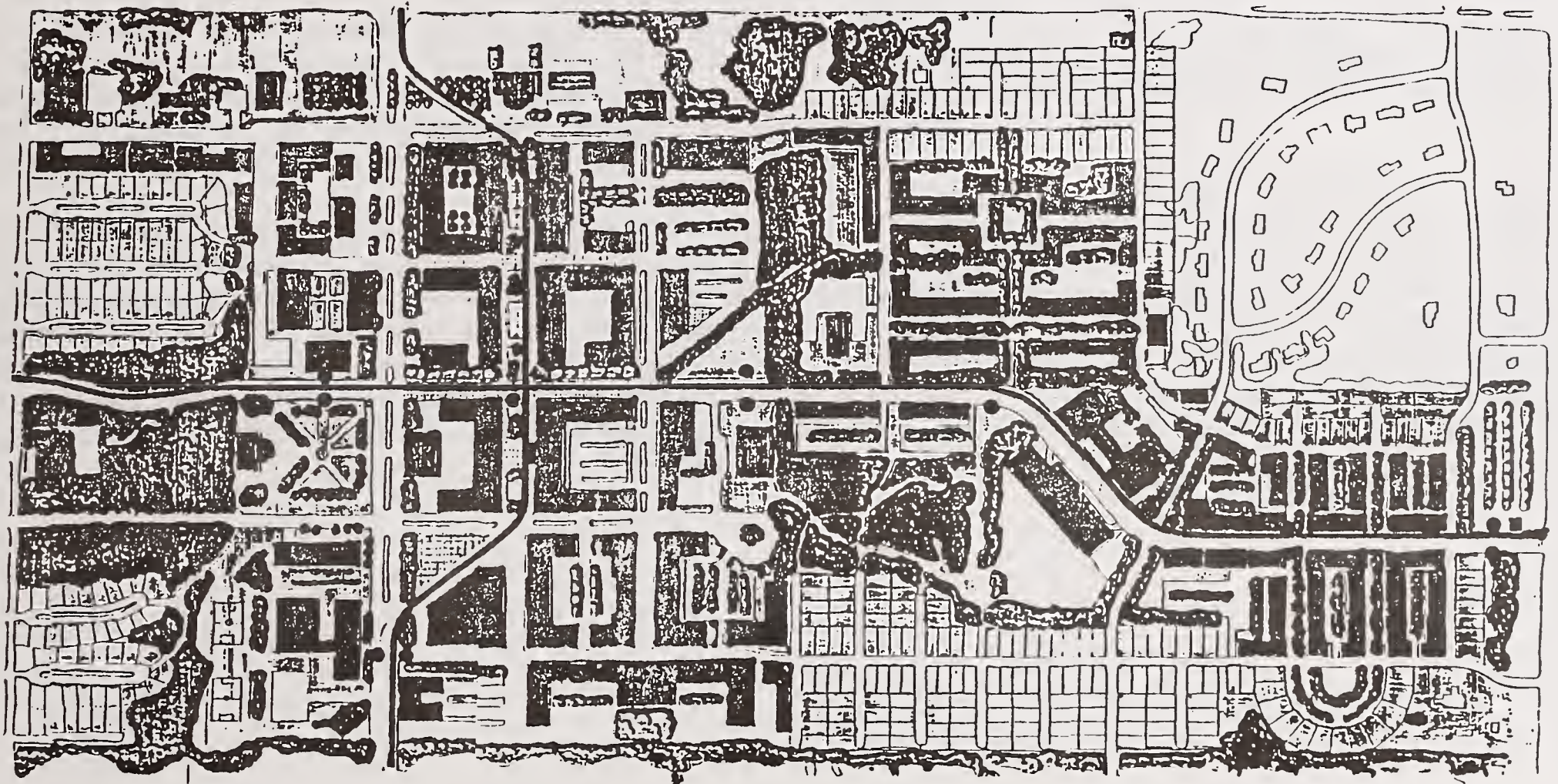
report. Technical questions such as lot size and block width, street connectivity and pedestrian patterns, were examined. Following this review a final design was developed which is explained in the following section.

PROTOTYPE DESIGN/RESULTS

First Prototype Design



PROTOTYPE DESIGN/RESULTS



PROTOTYPE DESIGN/RESULTS

Final Prototype Design

The final prototype design was developed to provide a test of the guidelines for transit-sensitive suburban planning and to demonstrate the concept of a transit corridor district as it might be developed in a suburban area. Several concepts were continued from the first prototype, however, the final design involves significant changes over the first effort. The final design was developed by a team of architectural faculty and students following the guidelines developed for this project.

Four districts were identified as a basis for design. These areas -- the Woods, the Farms, the Central District and the Estates Area -- were identified based on existing land use and/or the impact of the transit system on design. These themes helped to develop a basis for design and also help to illustrate how different approaches can be blended within a Transit Corridor District, as well as examining how the guidelines would be used by different designers working on five sites with varying topography and other natural features such as woods, lakes and wetlands.

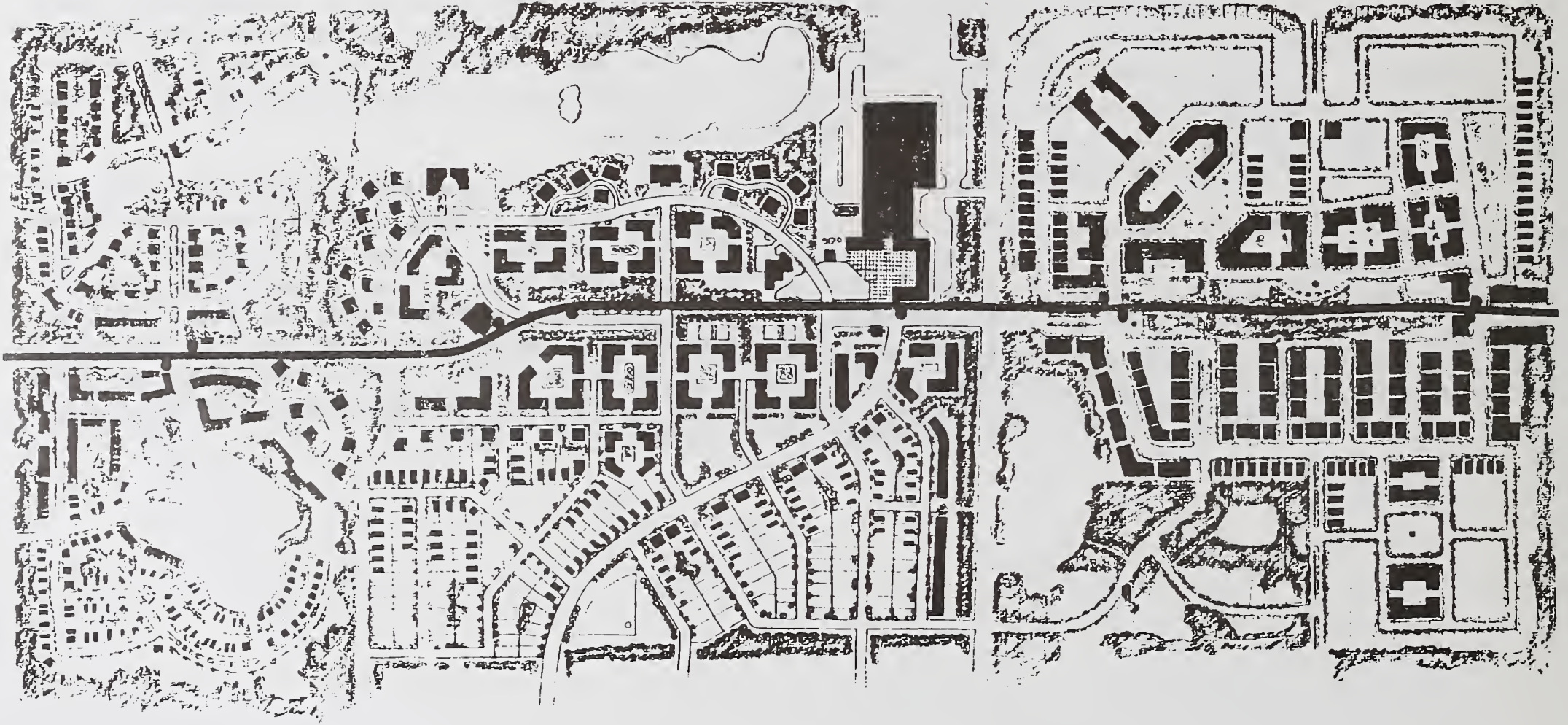
PROTOTYPE DESIGN/RESULTS

Overall Design

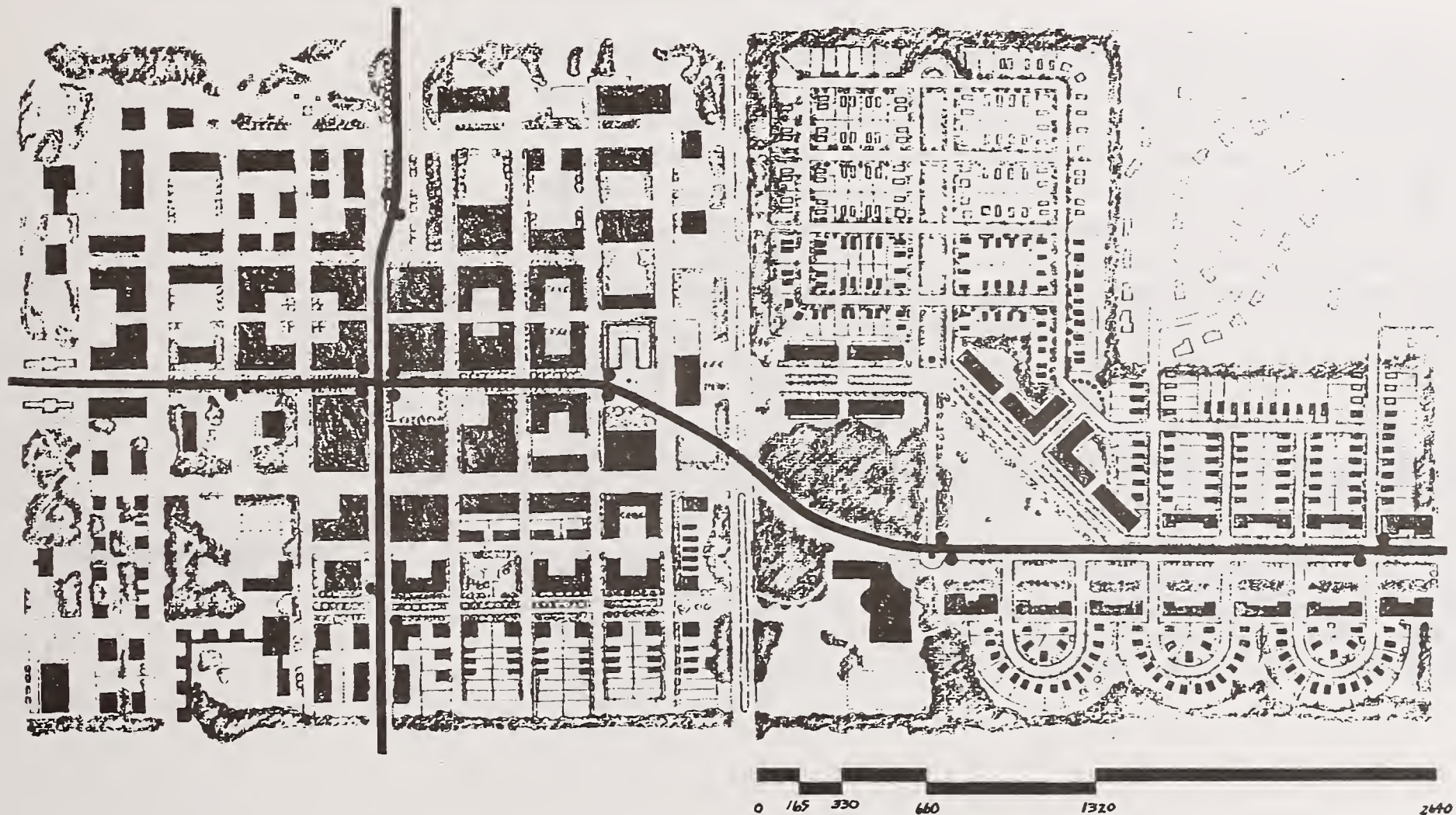
The overall design is shown on the following two pages. In general the design includes a band of high density housing and office facilities located along the east-west transit route and a lower density development at the fringes. A business district/civic center is located at the point of intersection of the two transit routes towards the east end of the site.

Smaller neighborhood business areas are located at other transit stops to the west. The plan would contain approximately 3,000 housing units and approximately 1,400,000 square feet of commercial/office space. Substantial retail areas are also included. This results in a net residential density of approximately 6.5 units per acre for residential areas only. Densities in individual areas may vary considerably ranging up to seven to ten residential units per acre near the center and eastern edge of the site. Commercial densities are highest in the central district and lower elsewhere. Actual densities could vary, however, depending on how individual lots and multifamily units were used.

PROTOTYPE DESIGN/RESULTS

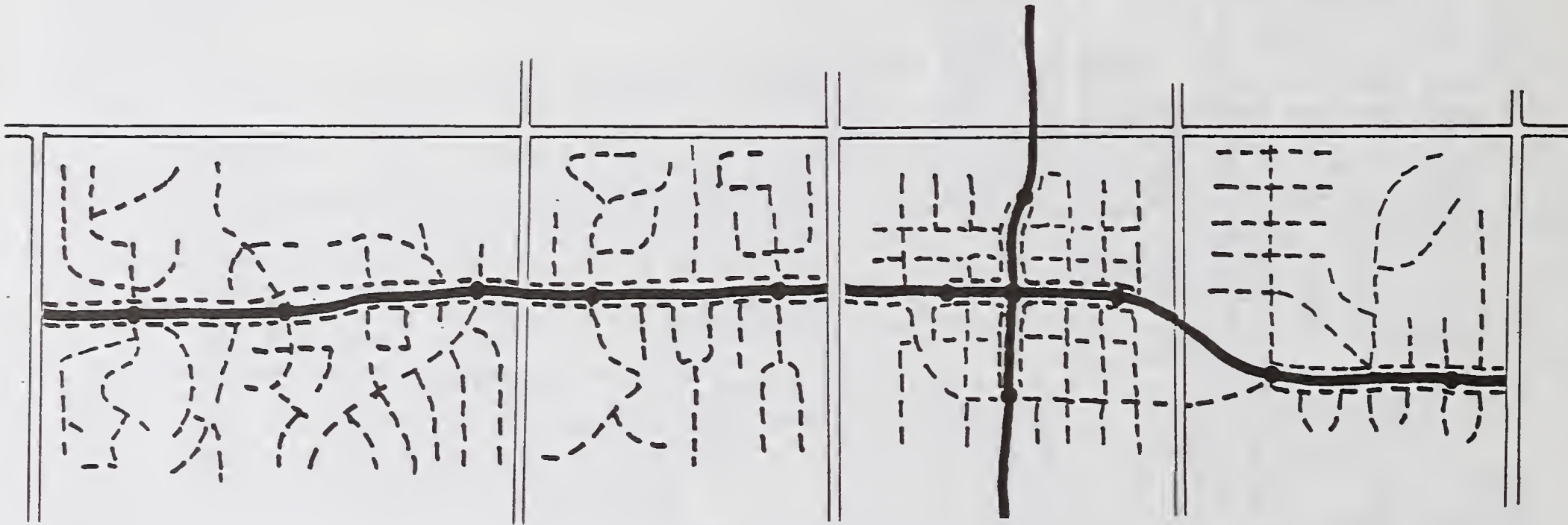


PROTOTYPE DESIGN/RESULTS



PROTOTYPE DESIGN/RESULTS

Location of pathways (dashed lines) and transit route (solid line).



PROTOTYPE DESIGN/RESULTS

Pathways/Transit Service

Pathways are provided for pedestrians and bicycles parallel to the transit corridor and leading towards it from surrounding land uses. There are three major breaks in the transit corridor where auto usage would be restricted. These occur midway between the north-south arterials in the west, center and eastern portions of the site. The breaks in the west and center areas occurs in largely residential districts. In these areas the pathway/transit corridor passes through open space/recreational areas. Multifamily housing units open out to these zones to maximize green areas related to the housing. The break to the east occurs in the central commercial district. In this area the two transit lines cross at a central square and a pedestrian zone is provided along the transit corridor. The east-west bicycle path is separated from the transit corridor at the central district. The bicycle pathway is several blocks south of the transit corridor. This permits easy through movement of bicyclists away from the commercial area, yet still maintaining bicycle access to buildings in the commercial district.

East-west auto travel through the site is possible but made somewhat difficult because of closure of the transit corridor. In most cases a loop collector street is provided which permits auto access into the site from the surrounding arterials. This follows the design goal of emphasizing transit and having a reduced role of the automobile.

PROTOTYPE DESIGN/RESULTS

THE WOODS

An existing lake/wetlands area remains undeveloped.

A small nature center overlooks this area. A pedestrian bridge connects the housing north of the lake to the boulevard leading to the transit stop

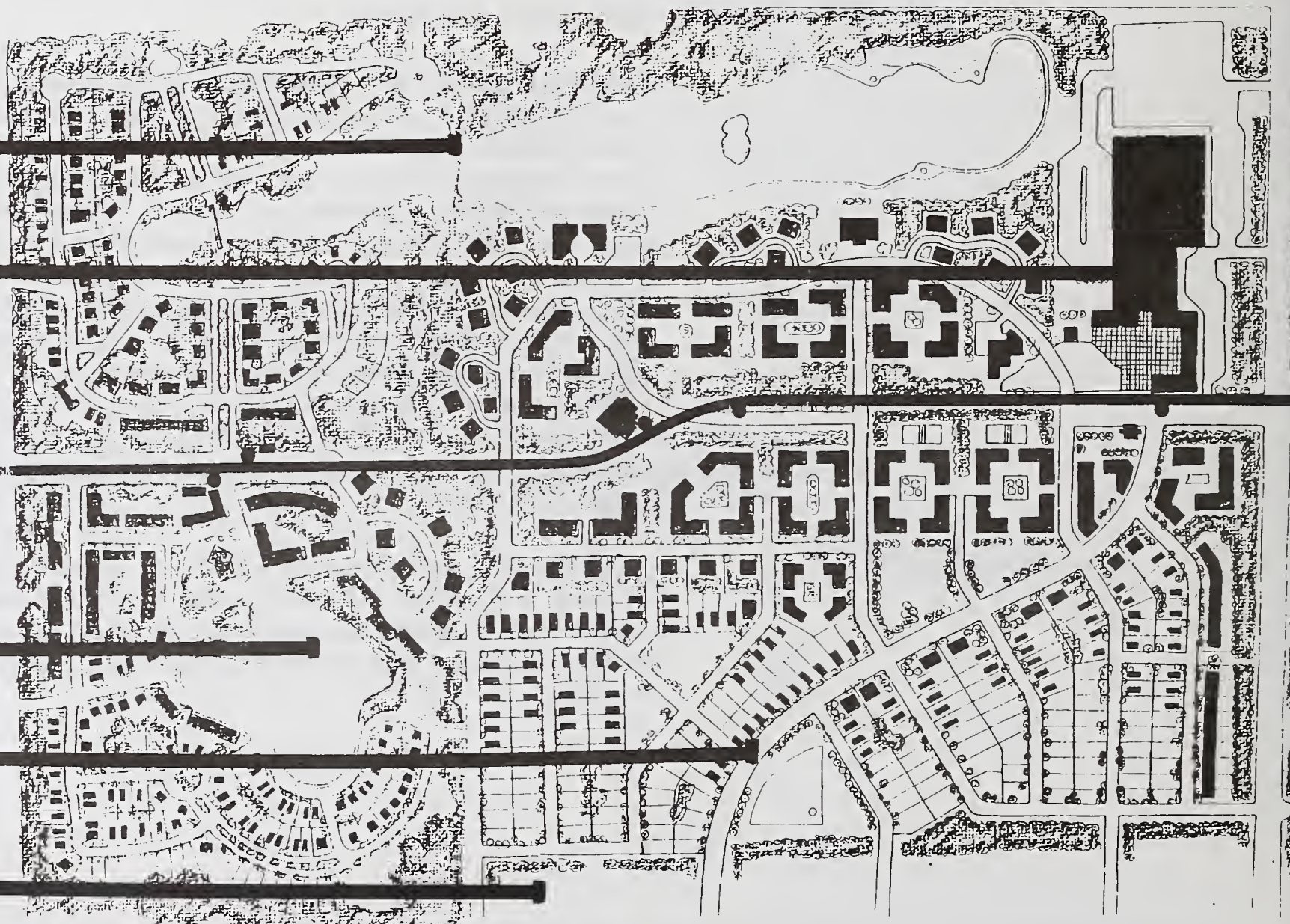
The shopping center is oriented to serve shoppers arriving by either auto or transit. A large parking lot with easy access to a main arterial serves the north end of the center. a parking ratio of pproximately 3 cars/ 1000 sq ft of GLA are provided.

The southern edge of the shopping center contain the transit stop and a pedestrian oriented plaza and pond. The parking ratio in this area is 1 car/1000 sq ft of GLA.

The western area of the site is heavily wooded and also contains a pond.

This collector street runs across a small ridge in this area and ends at the transit station

Larger parks are located at the edges of the TCD



PROTOTYPE DESIGN/RESULTS

The Woods

The westernmost segment of the TCD -- 'The Woods' -- lies between Marcy and One Mile Roads. As its name implies, this area has large, well developed wooded areas as well as open space. The area also includes a pond near the western edge and a large wetland to the north. Design in this area emphasizes the natural features of the site with wooded areas. The area will be family oriented with a mix of other uses. Upper income residential would be used in conjunction with the amenities of the site. The pond/wetland areas dominate the design with clusters of housing surrounding each area. Access for automobiles to the area would be from adjacent arterials. Street patterns within The Woods are strongly affected by the areas of water where roadways follow edges of the water. Elsewhere a more traditional curvilinear pattern is used.

One unique feature of the Woods is the shopping area located in the northeast corner at the intersection of Silver Spring and Marcy. This area is expected to be served by both autos and transit. Parking is located mostly on the arterial (north) side of the site, while the shops are located on the transit (south) side with a small plaza used to connect the buildings to the transit route. The shopping center would be relatively small, with several small shops/restaurants located at the south end and a larger building (discount store, etc.) to the north edge.

PROTOTYPE DESIGN/RESULTS

THE FARMS

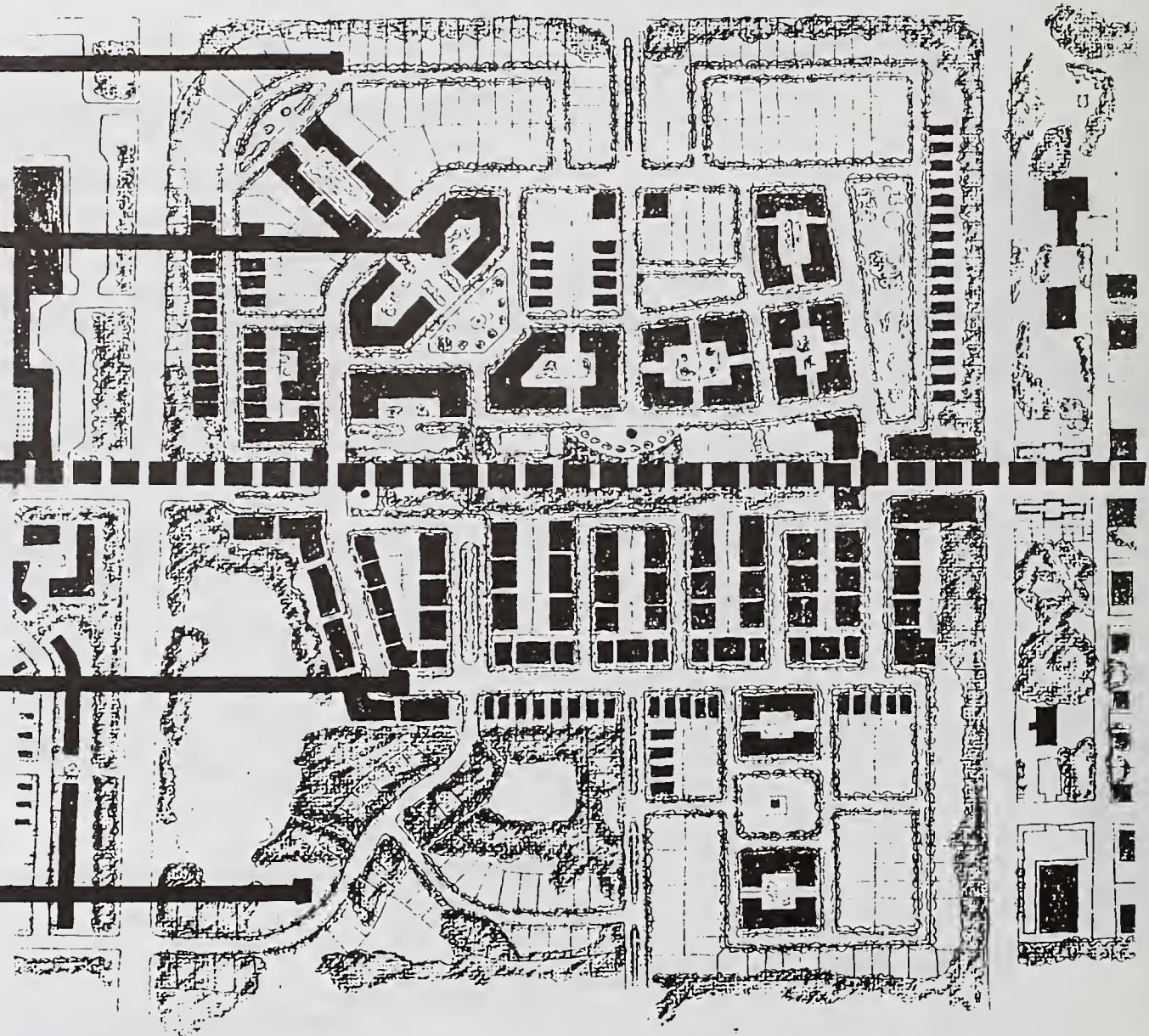
Deeper sites are located at the edge of this district to form a buffer between it and the arterials

Each quadrant of this area contains a neighborhood open space with a different character.

The transitway in this area is a linear park containing recreation areas such as tennis courts and soccer fields as well as paths leading to the transit stops

The collector road connects the quadrants of this tract and leads to the north south arterials as well as to the transit stop

This area of the tract has existing woods and a small pond and contains larger single family housing and large duplexes.



PROTOTYPE DESIGN/RESULTS

The Farms

The 'Farms' area is largely open and flat land and includes three farms located in this area. The Farms area consists of four quadrants, each with its own character and features. The overall area consists of a mix of land uses with a mixture of midrise, town house, duplexes, triplexes and single family housing. The two transit stops located in this area have small scaled retail and office uses.

The street pattern is mostly grid shaped with a distinctive loop collector street that allows auto access to different areas. Multifamily housing is located near the center of the area, with the open space/pathway/transit corridor located through the area.

PROTOTYPE DESIGN/RESULTS

THE CENTRAL DISTRICT

Uses near the arterial are auto oriented though they are only 2 blocks or one-quarter mile from a transit stop

A ring road for autos and servicing vehicles surrounds the core of the central district

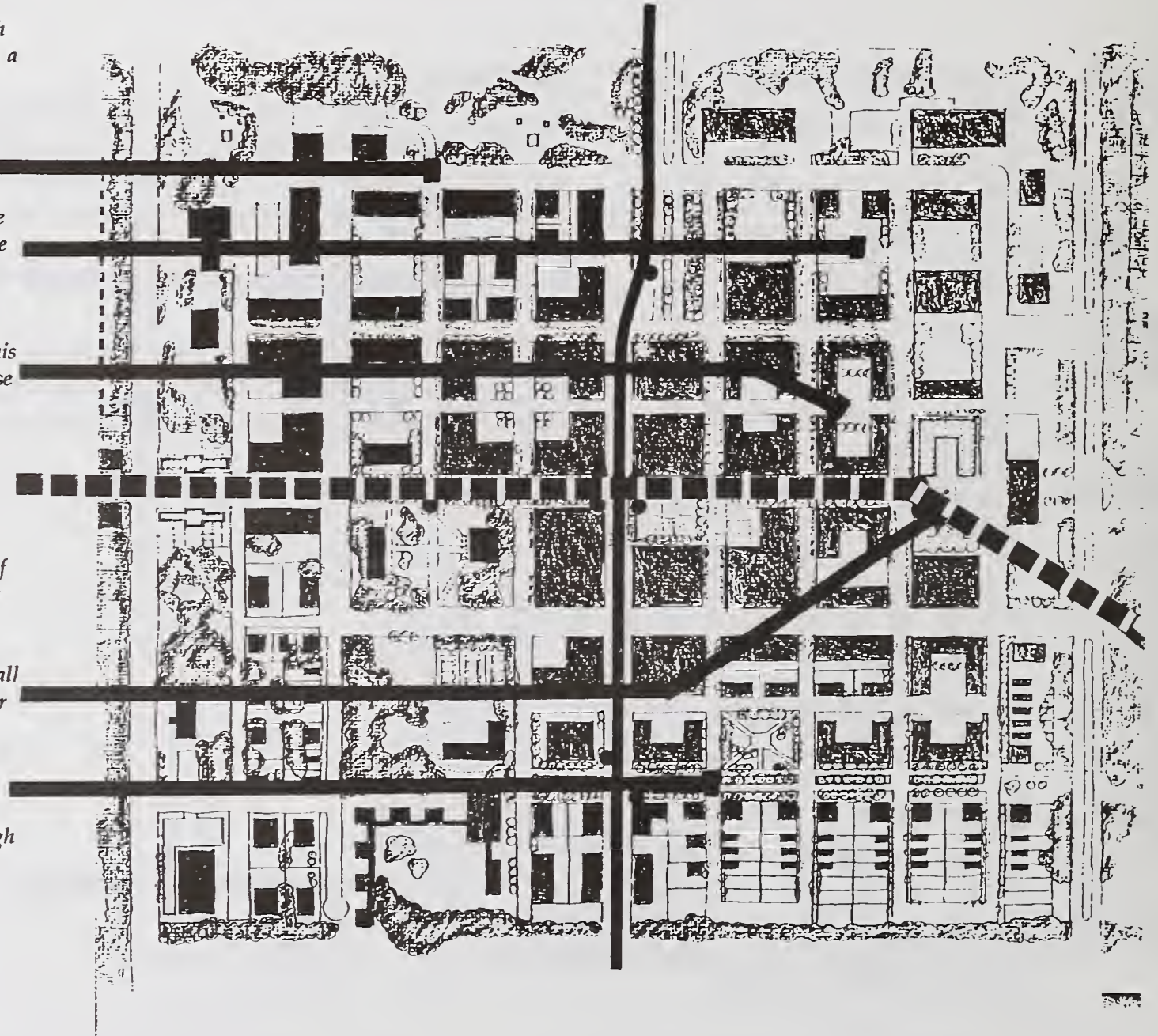
A parking structure and open lots are available for autos. Though many employees will arrive via transit the auto will still be used.

Woonerfs- pedestrian/service streets or courtyards are located in the densist part of this district. Buildings can be entered through these areas on the major streets

The Transitway in this district is pedestrian oriented with only transit vehicles and taxis allowed in order to minimize congestion and create a quality environment. Some 4,000 employees will eventually work within a block of this main street which also contains significant retail development.

A open market structure and indoor market hall ends the mainstreet area on the east. In winter the market becomes an ice-skating rink.

Housing is located in the southern part of the central district and focusses on a tree lined boulevard and plaza. The bicycle path, through the TCD uses this boulevard to bypass the transitway in this area.



PROTOTYPE DESIGN/RESULTS

The Central District

The Central District is the high density mixed-use center of the entire scheme. Two main transit lines intersect here and form a core area for a concentration of office and retail uses. Surrounding this area is high density housing for the elderly and single/couples with few children in the area. There would be few, if any, single family houses in the area.

Immediately west of the intersection of the transit routes a civic complex would be located in what is now a heavily treed area. This would consist of a city hall, police and fire station, churches, a library and an athletic club. A civic park forms the center of this complex. The east side of the central area features an open farmers market type area, convenient to housing and also served by the transit line.

PROTOTYPE DESIGN/RESULTS

ESTATES AREA

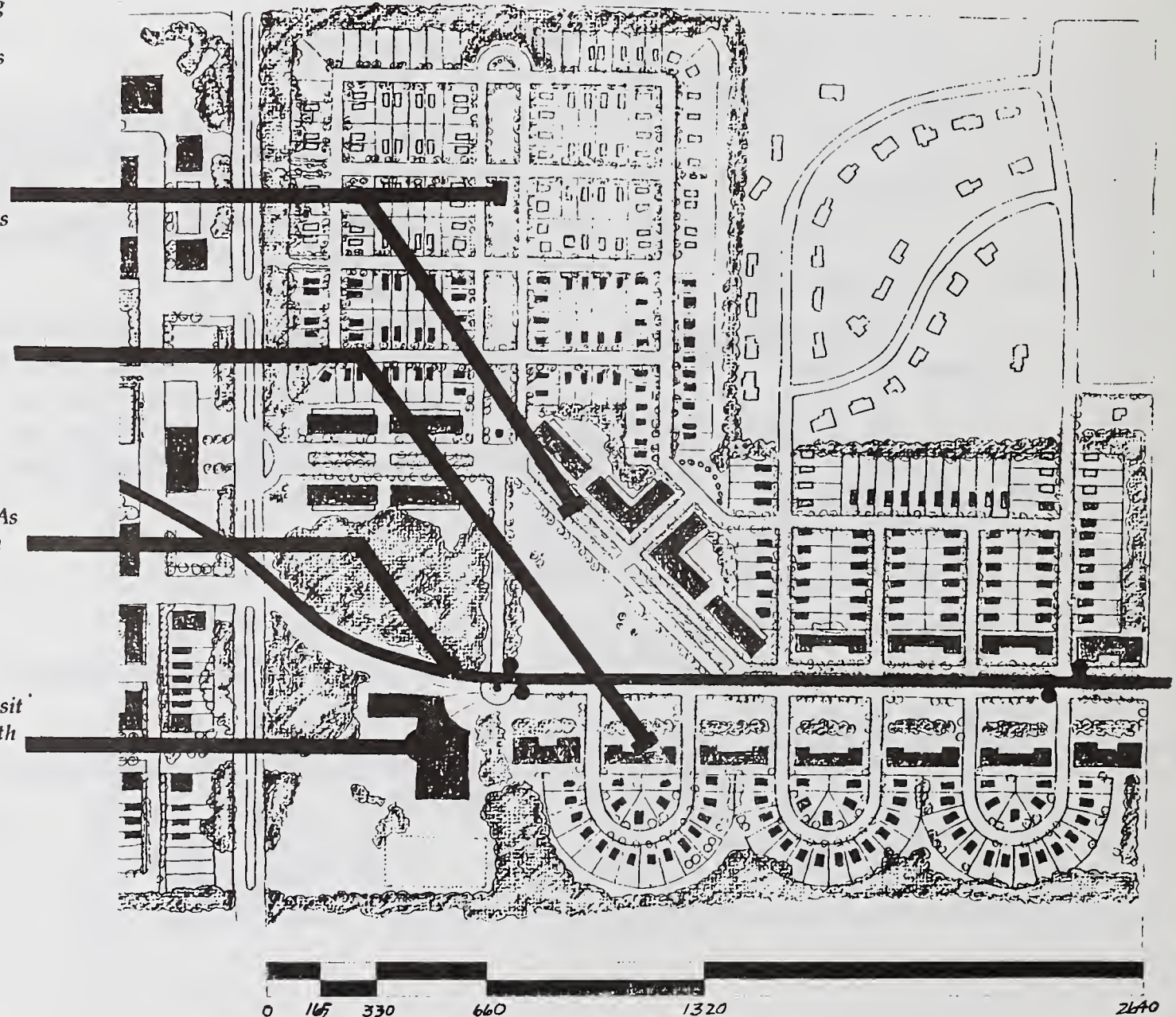
This area contains more single family housing than other parts of the site. 2, 3 and 4 unit houses are also used extensively to fit into this district.

Two major boulevards are the focus for this area. All housing is within a block of a boulevard, which are linear parks through this site.

Apartments face the boulevard and a central common for the entire area.

The transitway diverges from the collector streets and is routed through a wooded area. As the vehicles move through the site there are a variety of experiences for the transit riders.

An elementary school is located near the transit stop. An existing housing development south of the site is also part of the district for this school.



PROTOTYPE DESIGN/RESULTS

The Estates

The 'Estates' area, located east of the central district, is designed to fit between existing single family housing to the north and south of the site. This area would consist of mostly detached housing, however, a large number of the structures would be duplex and triplex type housing. Apartment units and garden apartments are located adjacent to the transitway. A formal grid street pattern is used in this area with boulevards forming the spine along both east-west and north-south axes of the site. A school is located on the southwest corner of the area. The school would be directly served by transit. Substantial open space is provided near the school for outdoor education and recreational use.

APPENDIX A

Table A-1: Transit Compatibility and Land Use

ITE Code	Land Use	Transit Compatibility Low \Rightarrow High 1 \Rightarrow 5	Peak Period? Yes or No	Potential Transit Users	Comments
010	Waterport	1	-	-	
*021	Commercial Airport	5	no	employees and travelers	luggage to carry
022	General Aviation Airport	1	-	-	
030	Truck Terminal	1	-	-	
090	Bus Park and Ride Station	5	yes	those on way to work	
110	General Light Industrial	2	yes	employees	
120	General Heavy Industrial	4	yes	employees	
*130	Industrial Park	4	yes	employees	
*140	Manufacturing	3	yes	employees	
150	Warehousing	2	yes	employees	
151	Mini-Warehousing	1	-	-	
170	Utilities	1	-	-	
210	Single Family -- detached	varies with density	yes	residents	
220	Apartment	1	no	residents-elderly	
*230	Residential Condominium	4	yes	residents-elderly	
240	Mobile Home Park	3	yes	residents-elderly	

APPENDIX A

Table A-1: Transit Compatibility and Land Use (continued)

ITE Code	Land Use	Transit Compatibility Low \Rightarrow High 1 \Rightarrow 5	Peak Period? Yes or No	Potential Transit Users	Comments
250	Retirement Community	4	no	residents-elderly	
260	Recreational Homes	1	-	-	
270	Residential P.U.D.	4	yes	residents-elderly	
410	Hotel -- Non-CBD	4	no	travelers and employees	
320	Motel	2	no	travelers	
330	Resort Hotel	1	-	-	
400	Recreational	varies with type	-	visitors and employees	
410	Park	2	no	visitors	
420	Marina	1	-	-	
330	Golf Course	1	-	-	
400	Theater	2	yes	visitors	evening use
450	Stadium	4	yes	spectators and employees	
501	Military Base	2	yes	military personnel	
520	Elementary School	4	yes	students	
530	High School	4	yes	students	
540	Junior/Community College	5	no	students	

APPENDIX A

Table A-1: Transit Compatibility and Land Use (continued)

ITE Code	Land Use	Transit Compatibility Low \Rightarrow High 1 \Rightarrow 5	Peak Period? Yes or No	Potential Transit Users	Comments
550	University	5	yes and no	students	
550	Church/Synagogue	2	-	-	weekend use
565	Day Care Center	1	-	-	
590	Library	3	no	visitors - kids	
610	Hospital	1	no	visitors - elderly and employees	
620	Nursing Home	1	-	-	
630	Clinic	2	no	patients - elderly	
710	General Office Building	1	yes	employees	
720	Medical Office Building	3	no	employees and patients - elderly	
730	Government Office Building	2	yes	employees and visitors	
731	State Motor Vehicle Dept.	1	-	-	
732	U.S. Post Office	2	yes	employees	
740	Civic Center	3	no	visitors	
*750	Office Park	4	yes	employees	
760	Research Center	2	yes	employees	
770	Business Park	3	yes	employees	

APPENDIX A

Table A-1: Transit Compatibility and Land Use (continued)

ITE Code	Land Use	Transit Compatibility Low \Rightarrow High 1 \Rightarrow 5	Peak Period? Yes or No	Potential Transit Users	Comments
810	Retail - General Merchandise	2	no	employees and shoppers	
812	Building Materials and Lumber	1	-	-	large purchases to carry
814	Specialty Retail Center	2	no	shoppers	
815	Discount Store	2	no	employees and shoppers	
816	Hardware/Paint Store	1	-	-	large purchases to carry
817	Nursery/Garden Center	1	-	-	large purchases to carry
820	Shopping Center	5	no	employees and shoppers	
831	Quality Restaurant	1	-	-	evening use
832	High Turnover Restaurant	2	no	employees and customers	
833	Fast Food - No Drive Through	2	no	employees and customers	
841	New Car Sales	1	-	-	
844	Service Station	1	-	-	
846	Car Wash	1	-	-	
846	Highway Oasis	1	-	-	
841	Truck Stop	1	-	-	
850	Supermarket	2	-	-	

APPENDIX A

Table A-1: Transit Compatibility and Land Use (continued)

ITE Code	Land Use	Transit Compatibility Low \Rightarrow High 1 \Rightarrow 5	Peak Period? Yes or No	Potential Transit Users	Comments
851	Convenience Market	2	-	-	large purchases to carry
860	Wholesale Market	2	yes	employees	short stay
870	Apparel Store	2	-	-	large purchases to carry
890	Furniture Store	1	-	-	large purchases to carry
895	Video Arcade	2	no	kids	
911	Walk-in Bank	2	no	customers	
911	Drive-in Bank	1	-	-	
913	Walk-in Savings and Loan	2	no	customers	
911	Drive-in Savings and Loan	1	-	-	
930	Insurance Building	3	yes	employees	
	* - Transit data in ITE trip book				

Appendix A

Table A-2: Transit Trip Making Rates^{30,31}

Land Use Category	Average Weekday Transit Trip Ends
Commercial Airport (021)	4.969/employee 2.300/average flight per day 41.253/commercial flight per day
Industrial Park (130)	0.025/employee 0.048/1000 sq. ft. gross floor area 0.685/acre
Manufacturing	0.088/employee 0.0831/1000 sq. ft. gross floor area 1.250/acre
Residential Condominium (230)	0.536/dwelling unit 0.203/person 0.433/vehicle
Office Park (750)	0.131/1000 sq. ft. gross floor area

³⁰Source: *ITE Trip Generation Manual*, 4th edition.

³¹Note: These data may be from limited studies and should be used with caution.

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